Exploration Overview 1990

Northwest Territories

Mining, Exploration and Geological Investigations

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Editor's Note: NTS geographical reference codes have been included for as many projects as possible. Tonnages are given in tonnes, ie. metric tons (t), and grades in grams per tonne (g/t), unless otherwise stated.

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EXPLORATION AND MINING OVERVIEW

INTRODUCTION

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SUMMARY OF EXPLORATION AND MINING

The commissioning of Colomac Mine increased the number of operating mines in NWT to seven: five gold and two base metal. No major interruptions of operations were reported at NWT mines in 1990 and therefore production in both volume and value should significantly exceed that attained in 1989.

Exploration continued to decline from previous levels. Claim staking for example declined by 31% (Table 1). It was concentrated in the Keewatin District (41%) (Table 2) where, on the other hand, mineral property exploration declined significantly from 1989 levels. Gold was still the prime target commodity but interest in base metals improved slightly, although this was not reflected in any significant increase in base metal oriented projects.

Although claim staking declined by approximately a third, significantly more prospecting permits were issued (Table 3). Claim staking in general results from prospecting and other geological work that identifies favourable ground. Prospecting Permit applications are probably more speculative, and are not as good an indication of exploration levels as claim staking.

The number of prospecting permits applied for was up considerably over 1989, and the number issued, 66 of 75 applications, has not been exceeded since 1983. Most of these permits, including all of the 23 issued on Baffin Island and the Melville Peninsula (both in the Rae Province), saw no work in 1990. Many of them will probably be relinquished in 1991 without work being done. For the first time in many years permits were issued in the Interior Platform (west of Great Slave Lake) where potential targets include Mississippi Valley type lead-zinc and diamond bearing pipes.

Diamond drilling (Table 4) was one of the few exploration-level parameters that showed an increase relative to 1989 levels. Surface drilling was up by just over 10%, but underground drilling was down proportionately. Two major surface drilling projects for gold in the Slave were major factors in this increase, whereas termination of the Noranda/Total Energold Tundra Project reduced underground drilling significantly.

As in the last 5 years, at least 50% of all projects were in the Slave Structural Province (Table 5) and the majority of these were for gold (Table 6). The major change in exploration was the increased proportion of projects that included drilling (Table 6). In 1989 51 projects (39%) included drilling or underground exploration. In 1990 the projects that included drilling (44) or underground development (4) represented 52% of all projects.

TABLE 1: MINERAL CLAIMS IN THE NWT
1984 to 1990
Claims (Hectares)

Year	Recorded	Cancelled	Good Standing
1984	488	4,222	36,528
	(240,900)	(472,323)	(2,878,225)
1985	461	6,565	30,398
	(294,887)	(455,237)	(2,704,790)
1986	531	5,655	25,226
	(360,361)	(339,468)	(2,721,985)
1987	843	6,031	20,052
	(552,385)	(430,657)	(2,829,403)
1988	1,098	4,448	16,702
	(739,928)	(464,348)	(3,115,083)
1989	500	249	15,976
	(321,633)	(153,818)	(3,155,551)
1990	425	854	15,477
	(281,902)	(437,392)	(3,029,271)

Table 2: Ground Staked By Geological Area
1986 To 1990
(Thousands of hectares)

Geological Area	Year 1986	1987	1988	1989	1990
Arctic Islands	1.0	0.0	0.0	15.4	38
Keewatin (Rae & Hearne)	71.9	88.9	260.6	139.3	117
SE Mackenzie (Rae Province)	1.0	1.9	22.0	1.9	1
Slave	209.5	372.4	423.5	203.8	87
East Arm	5.7	0.6	23.6	0.0	0
Bear	67.2	67.1	12.7	6.5	12
Interior Platform	67.2	0.2	0.0	19.2	27
Cordillera	0.0	0.8	1.8	23.5	0
TOTAL	**423.5**	**551.0**	**744.2**	**409.5**	**282**

TABLE 3: PROSPECTING PERMITS ISSUED 1980 TO 1990, IN VARIOUS GEOLOGICAL AREAS

AREA	YEAR										
	80	81	82	83	84	85	86	87	88	89	90
Arctic Islands	10	2	53	87	10	15	3	0	0	3	4
Cordillera	11	9	12	7	0	0	0	1	0	0	0
Interior Platform	0	0	0	0	0	0	0	0	0	0	4
Churchill Province (Rae/Hearne)	57	54	17	1	10	11	26	5	37	18	51
Bear Province	17	4	3	0	0	5	2	0	0	0	7
Slave Province	3	4	6	1	5	22	0	0	8	3	0
TOTAL	98	73	91	96	25	53	31	6	45	24	66

Exploration continued to decline from previous levels. Gold was still the prime target commodity (Table 6) but interest in base metals was proportionately higher than in 1989. Primary targets on the 92 properties worked during 1990 (127 in 1989), were gold on 57 properties (62%) and base metals (usually with silver) on 21 properties (ie. 23%; in 1989, 22 properties, ie. 17.5%). There were 6 projects for rare materials, 4 for uranium, and 1 primarily for PGE's.

TABLE 4: SUMMARY of DIAMOND DRILLING in the NWT, 1987-1990[1]

BY DISTRICT	1987	1988	1989	1990
Franklin (Arctic Islands)	28,504.0	25,988.1	19,758.80	12,036
Keewatin	32,867.6	38,107.9	7,996.81	12,068
Mackenzie	128,868.5	121,333.6	133,166.13	138,834
BY GEOLOGICAL AREA				
Slave	108,716.8	112,943.2	131,784.90	138,834
Bear	3,169.2	8,390.2	0.00	0.00
Churchill	46,964.5	Rae 9,516.9	5,887.10	2,625
		Hearne 28,556.4	2,109.20	9,443
Cordillera	244.5	0.0	0.00	0.00
Interior Platform	15,348.2	15,466.8	1,381.02	5,621
Arctic Islands	15,979.0	10,521.8	19,758.80	6,415
BY COMMODITY				
Uranium	8,664.1	9,516.9	5,887.10	5,390
Base Metals	43,852.2	53,157.5	27,605.90	17,804
Precious Metals (Au mainly)	133,164.7	113,524.4	134,230.64	142,478
Tungsten & Rare Metals	0.0	3,519.5	0.00	1,138
Platinum Group Elements	4,559.1	5,711.3	0.00	0.00
SURFACE DRILLING	140,101.1	140,393.1	79,762.58	88,193
UNDERGROUND DRILLING	50,138.9	45,036.5	81,158.16	74,745
TOTAL DRILLING	190,240.1	185,429.6	160,921.74	162,938

[1] data recorded in meters

TABLE 5: COMPARISON OF ACTIVITY IN VARIOUS GEOLOGICAL PROVINCES AND SUBPROVINCES

Geological Region	NUMBER OF PROJECTS EACH YEAR										
	80	81	82	83	84	85	86	87	88	89	90
Cordillera	29	24	12	11	11	7	4	2	1	5	1
Arctic Islands [1]	7	24	16	11	17	13	6	1	2	3	4
Keewatin [2]	53	59	34	25	19	17	21	17	33	14	13
SE Mackenzie [3]	14	25	10	11	9	3	1	6	13	7	2
East Arm	4	14	3	1	1	2	1	4	4	3	0
Great Slave Plane [4]	6	6	3	2	1	2	1	1	0	0	5
Bear Province	22	24	10	11	2	3	5	3	11	3	1
Slave Province	29	42	25	44	57	92	90	89	93	92	66
TOTAL	164	218	113	116	117	139	130	123	157	127	92

[1] Includes Baffin Island and Melville Peninsula, part of the Churchill Province, as well as the Arctic Archipelago.
[2] Churchill Structural Province in District of Keewatin.
[3] Churchill Structural Province in District of Mackenzie.
[4] Previously reported as "Pine Point".

EXPLORATION HIGHLIGHTS

As yet unconfirmed rumours of the discovery of a large diamond (nearly one carat) in the Mackenzie District appears to be the highlight of the 1990 exploration year. Although not the first diamond discovered in the NWT it would be the largest.

Gold exploration drilling on two properties in the northern Slave Province reached levels that suggest important discoveries have been made. One of these, Back River Joint

TABLE 6: 1990 EXPLORATION PROJECTS IN THE NWT BY GEOLOGICAL REGION

AREA	Gold	Uranium	Silver Base Metals	PGE	Rare & other Metals	Total Exploration	Mines Operating [Developing]
Slave Province	(30) 17 [4][1]	0	(9) 5	0	1	66	5 Au
Keewatin							
(Rae)	(1)	(1) 2	0	0	0	5	0
(Hearne)	(3) 5	0	0	0	0	8	0
SE Mackenzie							
(Rae Province	0	0	1	1	0	2	0
Bear Province							
(Wopmay)	0	0	1	0	0	1	0
(East Arm)	0	0	0	0	0	0	0
Cordillera	0	0	1	0	0	1	0
Interior Platform							
(Great Slave Plane)	0	0	0	0	(1) 4	5	0
Arctic Islands							
(Platform)	0	0	(3) 1	0	0	4	2 Pb & Zn
(Rae Province)	0	0	0	0	0	0	0
TOTAL	(34) 23 [4][1]	(1) 2	(12) 9	1	6	92 (48)[2]	7

Numbers in round brackets indicate the number of exploration projects with diamond drilling.
Numbers without brackets indicate the number of exploration projects without diamond drilling.
[1] Advanced projects with an underground component.
[2] Total projects with a drilling component.

TABLE 7: GEOLOGICAL SURVEY OF CANADA ADMINISTRATED MDA PROJECTS
Canada - Northwest Territories Mineral Development Agreement

Project	Description	GSC officer (Student or Contractor)
Regional Geology (LCSD)		
1. Contwoyto - Nose Lake area	Field work directed at understanding the regional tectonic setting of Lupin-type mineralization.	J. King (C. Relf, Ph.D., Queens)
2. Tavani Greenstone Belt	Map parts of 55 K/3, K/4, K/5, and K/6 at 1:50,000 scale with emphasis on geochemistry, geochronology, structure and stratigraphy.	S. Tella (S. Raiser, A. Park, U of New Brunswick)
3. Muskox Intrusion	Detailed mapping, geochemical and petrological study of marginal rocks of the Muskox Intrusion and selected areas of the Coppermine lavas and Mackenzie dykes to model magmatic processes and PGE deposition.	W.R.A. Baragar, (D. Frances, McGill)
4. Cameron River Volcanic Belt	Map at 1:50,000 Cameron River volcanic belt north of latitude 63°, and make a structural and stratigraphic analysis of the volcanic belt and adjacent granitoid and sedimentary terranes.	M. Lambert (D. James)
Mineral Deposits (MRD)		
5. Gold Metallogeny - Slave Province	To document gold deposits throughout the Slave Province, identify empirical exploration guidelines, improve genetic models, and assess the potential of areas where deposits have not been found.	C.W. Jefferson, *et al*
6. Gold Metallogeny - Churchill Province	Detailed mapping of gold showings in Henik Group greenstones and equivalents, investigating the impact of Archean sedimentation-tectonism and Proterozoic tectonism on the distribution of gold, and comparing gold metallogeny of Churchill with that of the Slave.	A. Miller
7. PGE in ultramafic /mafic rocks, NWT	Characterizing mafic-ultramafic bodies and their potential for magmatic sulfide (Ni-Cu-PGE) and oxide (Cr-Ti-V) deposits.	L. Hulbert et al
8. Rare Metals - Slave, Churchill and Bear provinces	Documenting rare metal distribution in deposits and the metal potential of alkalic igneous provinces, comparing the geochemical signatures of these rocks to similar geological environments in Canada.	W. Sinclair
9. Pine Point and Polaris deposits	1) Polaris: detailed underground and surface mapping and drill core logging, recognition and definition of regional and local markers in host rocks, study of "internal sediments" to determine their age and origin. 2) Pine Point: oxygen carbon, and hydrogen isotopes of gangue carbonates whose paragenetic relationships to ore have been established through previous studies; studying fluids involved in development of rocks and ore at Pine Point.	D. Sangster 1) R. Randall, Ph.D. U. of Toronto 2) H. Ching, Ph.D. McGill U.
10. Metal Stressed Vegetation	Using imagery map vegetation and till around gold- and PGE-bearing gossans; detect spectral anomalies of gold and related trace elements and PGE in vegetation along mineral belts; integrate the biogeochemical response of stressed vegetation with geology to deline belts of mineral potential.	A.N. Rencz
Quaternary Geology and Geochemistry (MRD)		
11. Gold and PGE in till Churchill and Slave provinces	Determining how Au and PGE mineralization is reflected in associated till and demonstrating till geochemistry as an exploration method, defining patterns of glacial dispersal in areas of gold and PGE mineralization in central Keewatin and Contwoyto Lake area.	W. Coker

DIVISIONS
LCSD - Lithosphere and Canadian Shield
MRD - Mineral Resources

Venture's George Lake property, has been a major exploration program for the last 5 years. The other project on a BHP-Utah property along the Hood River in 76 L is rumoured to have seen 100 holes drilled. Whereas the George Lake Property is hosted by iron formations in turbidite the BHP-Utah discovery is reported to be hosted by a shear zone in mafic volcanics.

Results from the Asamara-Comaplex exploration of iron formation hosted gold deposits north of Baker Lake (Tehek Lake) and on the Meliadine River near Rankin Inlet continue to be favourable.

Uncertainties about the price of gold, metal markets in general, high interest rates (which have resulted in tight money markets) and land claims issues in NWT have all contributed to the general decline of exploration.

GEOLOGICAL SURVEY WORK IN THE NWT

Three separate organizations conducted government financed geological work in the NWT in 1990. The Geological Survey of Canada (EMR) continued with a wide array of projects, but fewer had field work than in previous years. Some of these are the subject of abstracts in the second part of this overview but most are not otherwise discussed. The field components of most GSC managed MDA projects were completed last year. Mapping continued around the Lupin Mine (Nose Lake project, King and Relf), and in the Turner lake area (Gold Metallogeny Slave Province). GSC delivered MDA projects are listed in Table 7.

During 1990, the NWT Geology Division (DIAND) carried on its provincial-type mineral resource/geology responsibilities. These included: monitoring developments in mining, mineral exploration, diamond drilling and geology and reviewing mineral claim and Prospecting Permit techni-

TABLE 8: 1989-90 GEOLOGICAL CONTRACTS

	ADVISOR,UNIVERSITY	DESCRIPTION	(STUDENT, DEGREE)
1.	D. Kerr Environmental Consulting Services, Alberta	Reconnoitre surficial geology of the Yellowknife River Basin.	
2.	S.A. Bowring, Washington University of St. Louis	Geochronological studies in the Slave Province and mapping related to geochronological sampling, mainly in the Yellowknife area.	C. Isachsen, Ph.D.
3.	H. Helmstaedt, Queen's University	Map and study sheeted dyke complexes in KAM Group and sub-KAM stable shelf association, Yellowknife volcanic belt (85 J/9, 16).	
4.	G. Skippen, Carleton University	Studies of supracrustal rocks in the Torp Lake domain.	K. Venance, M.Sc.
5.	R. James Laurentian University	Study of auriferous iron formation, Tehek Lake area, Keewatin District.	A. Armitage, M.Sc. Liaison, Dr. S.P. Goff
6.	W.K. Fyson, Ottawa University	Study structure of Slave Province and relate structural succession to gold metallogeny.	
7.	A Lalonde, Ottawa University	Study the geology and structure in the region around the Turner Lake gold deposits.	S. Schaan, M.Sc.
8.	L. Aspler	Determine origin and economic significance of gossanous formations in the Hawk Hill Lake area, Keewatin District.	
9.	M. Zentilli, Dalhousie University	To investigate the occurrence and distribution of carbon, and the relationship of carbon to gold mineralization in the Gordon Lake area.	T. Stokes, M.Sc.
10.	E. Spooner, Toronto	Continue studies of quartz vein gold mineralization in the granitoid rocks of Anialik River granite gneiss.	A. Abraham, Ph.D.
11.	M. Jebrak, Montréal	Detailed mapping of an area around the Ida Point silver showings for M.Sc. thesis.	S. Leclair, M.Sc. J. Gebert, field advisor

1-9 NWT Geology Division (DIAND), 10-11 Canada-NWT MDA

TABLE 9: NWT GEOLOGY PROJECTS 1990

PROJECT	DESCRIPTION	GEOLOGIST IN CHARGE (Liaison)
1. INDIN VOLCANIC BELT	Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area and to elucidate the relations between the volcanic and sedimentary successions. Minimal field work was done in 1990.	Dr. J. Morgan (Dr. D. Atkinson)
2. YELLOWKNIFE VOLCANIC BELT	Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area and to elucidate the relations between the volcanic and sedimentary successions.	H. Falck (Dr. D. Atkinson)
3. CARP LAKE (85 P/NE)	Mapping (1:50 000) of an area of complex geology with potential for various gold, silver and base metal deposits.	Dr. M. Stubley (Dr. D. Atkinson)
4. ARCTIC SOUND (76 N) MARA RIVER (76 K)	Mapping (1:50 000) of the lower Hood-James River area, an area that contains abundant turbidite sediments hosting Lupin-type (banded iron formation) gold deposits.	R. Johnstone (V. Jackson)
5. RIDEOUT ISLAND (76 O)	Mapping (1:50 000) of an area with abundant volcanic rocks with native silver, volcanogenic massive sulphide and gold potential.	J. Gebert (Dr. W.A. Gibbins)
6. HEPBURN ISLAND (76 M) KATHAWACHAGA LAKE (76 L)	Mapping (1:50 000 and 1:25 000) of granite-greenstone terrains. Field work was concentrated in 76 L/SE.	V. Jackson
7. SLAVE PROVINCE (86 G)	Mapping and collecting material for geochronology and petrological studies of gneissic terrain (pre-3.5 Ga).	Dr. W.A. Padgham Dr. S.A. Bowring
8. REID LAKE (85 I/11)	Studies of turbidite-hosted mineral deposits in the western part of the Yellowknife sedimentary domain. Final open file report released in 1990.	J.B. Seaton

1-5 are Canada-NWT MDA projects, 6-8 are NWT Geology Division projects.

cal assessment reports, all required under the Canada Mining Regulations. As well we conducted mineral deposit studies, geological mapping, and collected material and information to be made available through the mineral exploration archives and the C.C. Lord Core Library. A 136 page field guide to selected mineral deposits of the Archean Slave Province was prepared for the International Association on the Genesis of Ore Deposits (IAGOD) Field Trip #13. This was published as Geological Survey of Canada Open File 2168. Twenty-one people from nine countries (and five continents) took part in the field trip which was directed by NWT Geology staff and mining company geologists.

Public releases during 1989 included 26 open file maps and reports, a preview of 1990 mineral exploration, and this overview of mining, exploration and geological research. A list of all Division publications is available from the NWT Geology Division in Yellowknife. This list is regularly updated. Publications are also indexed in GEOSCAN, a listing that is updated yearly.

Geological studies were supported under 9 contracts (Table 8), one to a consulting company, one to a private consultant, seven to Canadian universities and one to an American university. In addition, the NWT Geology Division provided technical direction, logistical support and, in some cases, equipment, supplies and field personnel to assist the Canada-Northwest Territories Mineral Development Agreement NWT (MDA) projects described in Table 9. These projects were co-ordinated with the GSC MDA projects listed in Table 7. Considerable operational savings have been effected by co-ordination of logistics and technical field support, particularly expediting, between MDA and A-base programs, and between programs administered by NWT Geology Division, the NWT MDA and the GSC.

NWT Geology Division projects conducted in 1990 are also listed in Table 9. Val Jackson (Project Geologist) completed mapping of the Kathawachaga Lake area (76 L). Other geological staff continued with geological studies on various topics, but the technical support requirements of the NWT MDA and the need to review many millions of dollars

GNWT / DIAND

☐ GNWT GEOLOGISTS

1 UPPER BEAULIEU – M. STUBLEY
2 LOWER HOOD/JAMES RIVER – R. JOHNSTONE
3 HOPE BAY – J. GEBERT
4 INDIN LAKE – J. MORGAN
6 YELLOWKNIFE – H. FALCK

■ CONTRACTORS

6 HOPE BAY/IDA POINT
– M. JEBRAK, UNIVERSITY of QUEBEC at MONTREAL

GEOLOGICAL SURVEY of CANADA

● GEOSCIENCE PROJECTS

REGIONAL GEOLOGY

7 CONTWOYTO LAKE/NOSE LAKE – KING/LCSD
8 TAVANI GREENSTONE – TELLA/LCSD
9 MUSKOX INTRUSION
10 CAMERON RIVER

MINERAL DEPOSITS

11 PGE in ULTRAMAFICS/MUSKOX – HULBERT/MRD
12 PINE POINT/POLARIS – SANGSTER/MDR
VARIOUS GOLD METALLOGENY/SLAVE – JEFFERSON/MRD
VARIOUS GOLD METALLOGENY/CHURCHILL – MILLER/MRD
VARIOUS RARE METALS – SLAVE/CHURCHILL/BEAR – SINCLAIR/MRD
VARIOUS CLAY MINERALOGY/URANIUM – MILLER/MRD

Figure 1: Canada-NWT Mineral Development Agreeent, GNWT.

of assessment work generated during the recent exploration boom severely restricted progress on these.

The Canada-Northwest Territories Mineral Development Agreement progressed satisfactorily on most fronts in 1990. The field work for Keewatin projects were completed in the 1989 season.

An Annual Report (1989) of Canada-NWT Geoscience projects was produced by the MDA office. This report gives details on the NWT MDA projects and included summaries of MDA contract projects and GSC-MDA projects.

CANADA-NORTHWEST TERRITORIES MINERAL DEVELOPMENT AGREEMENT 1987-1991

Martin Irving
MDA Coordinator
Yellowknife

The Canada-NWT Mineral Development Agreement (MDA) terminates on March 31, 1991. During the three and a half year term of the MDA, support has been provided to more than 30 geoscience projects, 10 technology (Northern Technology Assistance Program) projects and 15 information programs (Northern Mining Information Program).

The Agreement is administered by a management group consisting of W.A. Padgham (NWT Geology Division, DIAND), G. Patterson (Energy, Mines & Petroleum Resources, GNWT), M. McMullen (Mineral Policy, Energy, Mines & Resources, Canada) and P. Lee (Economic Development & Tourism, GNWT); A. Redshaw (Department of the Environment) is an ex-officio member. The management group reviews and approves all acceptable applications.

The many projects supported by the Geoscience program have produced over 80 maps and reports, with more to follow in the coming months. This year, most projects did not have a field component. However, a number of field projects were supported, some with significant results. The areas of field work are shown in Figure 1. Nineteen projects were supported: 8 by the GNWT/DIAND and 11 by the GSC. The budget for 1990/91 is $964,000.

The Technology Assistance Program supported three projects these year, all continuations of work started in previous years. All projects were supervised by CANMET - EMR Canada. The budget for 1990/91 is $205,000.

Due to budget constraints only one Information project was supported this year at a cost of $4,000. Requests for products from past years continue and will be filled as long as supplies last.

TABLE 10: PRODUCTION ESTIMATES FOR MINES OPERATING IN THE NORTHWEST TERRITORIES DURING 1990.

		1989			1990	
Mine	Commodity	Ore milled[1]	Production[1]	Reserves[2]	Ore milled[3]	Production[3]
Nerco-Con[4]	gold	239,500 t	2,955 kg Au	2.69 Mt 10.36 g/t Au	258,614 t	3,332 kg Au 666 kg Ag
Giant	gold mine	357,400 t	2,584 kg Au	1.06 Mt 9.55 g/t Au	337,074 t	3,112 kg Au 828 kg Ag
	tailings	992,640 t	686 kg Au	N/A	N/A	N/A
Ptarmigan	gold	48,140 t[5]	450 g/t Au[5]	100.6 kt[6] 11 g/t Au	56,994 t	520 kg Au
Colomac	gold	--	--	24.25 Mt 1.88 g/t Au	N/A	N/A
Lupin	gold	625,000 t	6,082 kg Au	3.94 Mt 10.63 g/t Au	641,778 t	6,228 kg Au 1,009 kg Ag
Nanisivik	zinc, lead, silver	706,000 t	57,000 t Zn 2,200 t Pb 16,300 kg Ag	2.975 Mt 8.5% Zn 0.3% Pb 41 g/t Ag	717,862 t	55,071 t Zn 3,053 t Pb 17,777 kg Ag
Polaris	zinc, lead	1,023,300 t	139,207 t Zn 32,066 t Pb	13.06 Mt 14.3% Zn 3.8% Pb	987,526 t	152,608 t Zn 39,338 t Pb

N/A: not available at time of writing.
sources: [1] company annual reports.
[2] reserves on December 31, 1989 (proven and probable).
[3] estimate based on monthly production figures (Jan. to June) submitted to the Mines Inspection Division, GNWT.
[4] 1989 production and reserve information from form 10-K and mine personnel.
[5] estimate for calendar year calculated using information from quarterly and annual reports.
[6] includes measured, indicated and inferred reserves on July 31,1990.

Figure 2: Mines operation in the Northwest Territories during 1990.

Discussions are on-going between the federal government and the GNWT concerning a second MDA. Your comments and ideas on programs or projects for a second MDA would be appreciated.

OPERATING MINES

Carol Ellis
NWT Geology Division, DIAND

Six mines, four gold and two lead-zinc mines, were operating in the NWT at the beginning of 1990 (Fig. 2). Production estimates for the producing mines are given in Table 10.

Colomac Mine came into production during the year. In early July, Urangesellschaft Canada Ltd. announced that it had asked the FEARO panel to delay indefinitely environmental assessment hearings on the development of the Kiggavik uranium deposit. Pine Point finished shipping zinc concentrate from the mine site in September, but will continue to ship lead concentrate into 1991.

Mill expansion at **NERCO Con Mine** (85 J/8) will be completed in December. A 10 by 15 ball mill was added in the primary circuit and a thickener, agitator and floatation column, which will produce a concentrate from refractory ore, will be added, increasing the capacity to 1090 t/day. Production was from 3900-ft, 4100-ft and 4500-ft to 5500-ft levels; development was also done on the 5700-ft and 5900-ft levels. In June, Nerco began using the rehabilitated C1 shaft to skip ore from the 2300-ft and 2900-ft levels; the 2600-ft level was rehabilitated for production. The Campbell shear zone will have been explored by approximately 54,900 m of underground drilling.

Production from B1 and A1 open pits at **Giant Mine** (85 J/9) was completed in August; mining from all open pits has been completed. Underground production was from ASD, trough and GB zones and from the A-shaft area. A ramp was driven from the bottom of A2 pit to the 575 level to access the A shaft area. By year end, 13,115 m of underground ore definition and exploration will be completed. Recovery grades were as expected at the tailings retreatment plant, but a lower number of tons were processed than anticipated. On

November 2, 1990, Royal Oak Resources Ltd. acquired control of the Pamour group of companies for $33 million.

At **Ptarmigan** Mine (85 J/9) mining took place on the 450-ft and 750-ft levels and broken ore was removed from the 150-ft and 300-ft levels. The mill achieved its capacity of 180 t/d over the last six months. Treminco Resources explored the area between Ptarmigan Mine and Tom Mine to the north with roughly 2440 m of exploration drilling. A gold-bearing zone was delineated in C-vein. At Tom Mine, a ramp to the second level will be completed in December. Although Treminco has retained its option on the Crestaurum property north of Yellowknife, no exploration was done this year.

NorthWest Gold Corp., formerly ABM Gold Corp., owns **Colomac Mine** (86 B/6). Northgate Exploration Ltd. has a 52% interest in NorthWest Gold. Construction was completed in March at a cost of roughly $166 million. This open pit mine is designed to produce 200,000 oz of gold per year at a cost of US$260/oz. Milling commenced in May and the first gold was poured on May 29. Colomac Mine is expected to attain commercial production levels of 9100 t/d in the fourth quarter.

By year end mining will be completed in the East zone of **Lupin Mine** (76 E/14), above the 330-m level, except for the crown and nose pillars. In the west zone mining continued in the 330-m to 250-m stope and started on the 570-m to 490-m stope. Production from the Centre zone continued from the 490-m to 410-m and 410-m to 330-m stopes and commenced from the 570-m to 490-m stope. The West zone contributed roughly 40% of mill feed; the Centre zone, 55%; and the East zone 5%. Approximately 13,000 m of underground drilling will be completed this year: 60% for ore definition and 40% for exploration. Shaft deepening from the 890 m to 1240 m, which began in late 1989, will be completed by year end, including the development of ore and waste pockets at 1105 m. The ramp was extended to the 890-m level. Backfilling commenced to stabilize the ground in the mine and to enable the recovery of sill and crown pillars. The tailings line was extended in the tailings pond and a dam to contain solids was built for this new tailing exit area.

At **Nanisivik Mine** (48 C/1) production was from the Main Lens, mainly the Central and West zones, from the East and Central Lower Lens zones and from Shale Hill and Oceanview satellite zones. Roughly 45% of the mill feed was from the Main Lens. Approximately 9220 m of ore definition drilling and 6500 m of exploration drilling will be completed by year end. A ramp collared below the east open pit was driven to the East Lower Lens.

Production at **Polaris Mine** (68 H/8) was from stopes in the Central Keel zone and from pillar recovery in the south Panhandle zone and South Keel zone. Parts of the lower South Keel zone were developed for production; development continued in the South Keel zone. Ore outline drilling comprised 6248 m from surface and 1362 m from underground. To reduce the concentration of metals in water released into the ocean, an ice-core dam was built across Garrow Creek.

SLAVE STRUCTURAL PROVINCE

Dorothy Atkinson, John A. Brophy and W.A. Gibbins
NWT Geology Division, DIAND

Exploration was for gold unless otherwise stated.

NORTHEASTERN SLAVE STRUCTURAL PROVINCE

Cogema Canada Ltd. staked the EDY and LACH claims in the Torp Lake (Turner-Pistol) Belt (3, Fig. 3; 76 N/5 & 6). In the Hope Bay Belt, **Noranda Exploration Company Ltd. (NPL)** drilled the "Wombat" or "Granite" showing on the CAPE-DOK-LARK group (1, Fig. 3; 77 A/3) and **BHP-Utah Mines Ltd.** did reconnaissance and staked the KAMIK claims (2, Fig. 3; 76 O/15).

ANIALIK BELT

In the east-central Anialik Belt (6, Fig. 3; 76 M/11), **Covello, Bryan and Associates Ltd.** supervised drill programs at 5 widespread sites on the TAM, TELLY, JOY, and ANIALIK claims (9 holes, 606 m). Another drill program was done on the CHAR group (1 hole, 81 m) in the northern Anialik Belt (4, Fig. 3; 76 M/10,11,14 & 15), where additional claims (JOR-MATT-KRISTA ADAM) were staked. All work was done on behalf of **Continental Pacific Resources Ltd.** In the south Anialik region (8, Fig. 3; 76 M/5), **BHP-Utah Mines Ltd.** did reconnaissance mapping and prospecting on Prospecting Permit 1181, which includes their ARNICA group.

HIGH LAKE BELT

In the southern part of the High Lake Belt (10, Fig. 3; 76 L/10,14 & 15), **BHP-Utah Mines Ltd.** conducted an extensive exploration program, including drilling of about 100 holes, near their "Crown Camp" on the ULU claims. Additional work in the area included prospecting, mapping and a small drilling program on the PULSE claims, and surface exploration and geophysical surveying on the DEN and FIDO group, optioned from **Aber Resources Ltd.** On FIDO 3, five holes totalling 174 m were drilled. **BHP-Utah Mines Ltd.** also staked the BAMAKO and PARIS claims in the central part of the belt (9, Fig. 3; 76 M/2 & 3) and conducted grassroots exploration on the HOTEL claims in the east arm of the belt (11, Fig. 3; 76 L/16).

In the northern part of the High Lake Belt (7, Fig. 3; 76 M/2,3,6 & 7), **Covello, Bryan and Associates Ltd.** mapped the high-grade volcanogenic massive sulphide copper deposit at HIGH LAKE for **Kennco Explorations (Canada) Ltd.** and supervised drill programs on the MONA (3 holes, 232 m) and CHARLIE (1 hole, 63 m) claims for **Continental Pacific Resources Ltd. Continental Pacific Resources Ltd.** also staked the nearby JON and KATH claims. On the KLC property to the south of High Lake, **Cominco Ltd.** drilled two deep holes to test a geophysical conductor delineated in a 1984 survey. The conductor was caused by graphite. **BHP-Utah Mines Ltd.** prospected and mapped the ROMA group east of the High Lake deposit, and completed geophysical surveying and 1:10,000-scale mapping on the CYGNET claims at the northern extremity of the High Lake Belt (5, Fig. 3; 76 M/10).

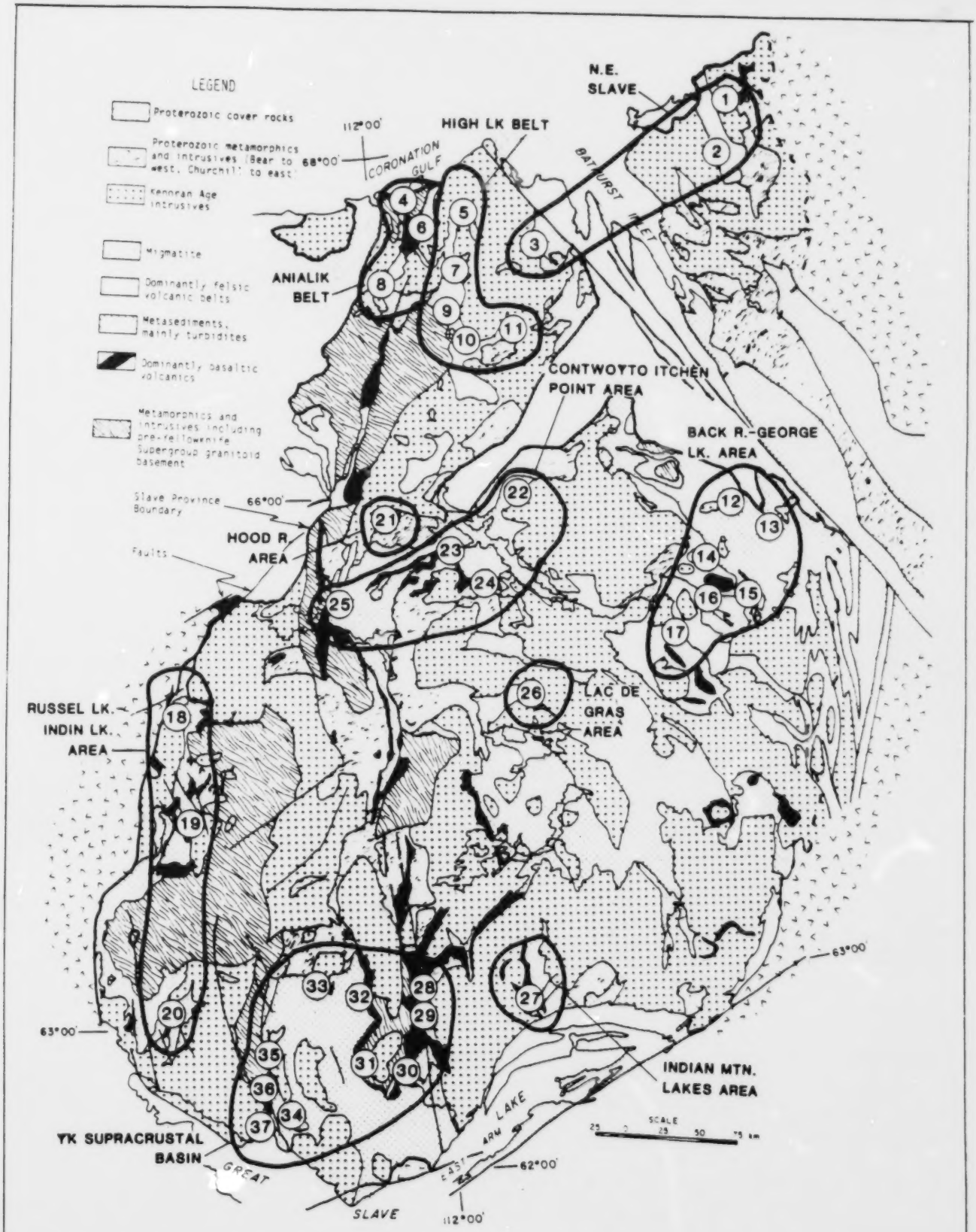

Figure 3: Mineral exploration in the Slave Structural Province, 1990.

GEORGE LAKE-BACK RIVER AREA

Gold-bearing iron formation is the main exploration target in this region.

In the George Lake Belt, **Trigg Woollett Olson Consulting Ltd.** managed a major exploration program on behalf of the **George Lake Joint Venture (Homestake Mining Company Ltd. and Kerr-McGee Corporation)** on the BRAU claims (12, Fig. 3; 76 G/11,13 & 14). Work included mapping, magnetometer and VLF-EM surveying, prospecting, sampling, structural and stratigraphic studies, and completion of 159 drill holes totalling 28,000 m. On adjacent properties, **Echo Bay Mines Ltd.** conducted reconnaissance mapping and prospecting on the RAP-WR-IPG-PEW-SEL-LOW group obtained under option from **Aber Resources Ltd.**, and **Cogema Canada Ltd.** explored for epigenetic vein-type mineralization on the DEX claims.

At Boot Lake (13, Fig. 3; 76 G/9), **Trigg Woollett Olson Consulting Ltd.** mapped, sampled and completed ground geophysical surveys on another group of BRAU claims and, at Needle Lake (15, Fig. 3; 76 G/3), drilled 13 holes totalling 1300 metres on a third group of BRAU claims. Work at Needle Lake, Boot Lake, and various other smaller projects in the region was done on behalf of the **Back River Joint Venture (Homestake Mining Company, Kerr-McGee Corporation** and the **Mac Lab Group**).

In the Regan Lake area, **BHP-Utah Mines Ltd.** completed 1:10,000-scale geological mapping and ground VLF-EM and magnetometer surveys over parts of the RAJAH and PRIMERO claims (16, Fig. 3; 76 G/4 & 6), and **Cogema Canada Ltd.** did detailed mapping and sampling on part of the GAET group (14, Fig. 3; 76 G/5 & 12).

In the Esker Lake area (17, Fig. 3; 76 F/1 & 2), **Equity Silver Mines Limited** conducted exploration on the MUS-KOX-WASP-UP group under terms of a joint-venture agreement with **Argus Resources Ltd.** and **Sirius Energy Corporation Ltd.**

HOOD RIVER VOLCANIC BELT

On the HOOD claims south of Takijuq Lake in the Hood River Volcanic Belt (21, Fig. 3; 86 I/2), **Falconbridge Limited** relogged and resampled core from the #10 Zone and conducted detailed mapping and lithogeochemical sampling near the #10 Zone and other copper-gold-silver massive-sulphide bodies on the property.

RUSSELL LAKE-INDIN LAKE AREA

In the Russell Lake area, **Aber Resources Ltd.** drilled 680 m in four holes to probe gold-bearing iron formation on the BUGOW claims (20, Fig. 3; 85 O/4). **Fortune Minerals Limited**, in joint venture with **Asarco Exploration Company of Canada Ltd.**, mapped, sampled and prospected the YELLER claims to the northeast of the Aber ground.

In the Indin Lake Supracrustal Belt, **Noranda Exploration Company Ltd.** drilled 742 m in 6 holes to test for base metals on the MESA claim (18, Fig. 3; 86 B/14). **Echo Bay Mines Ltd.** did some mapping and completed an IP survey over the Cass zone on the KIM claims (19, Fig. 3; 86 B/6), and **Stratabound Minerals Corp.** did 1:2,000-scale mapping on the NAM 3 claim to the west. Northeast of the KIM group, **North West Gold Corp.** cut 150 line-km of grids for geophysical surveys on the BAT-ED-CDC group, obtained under option from **Comaplex Resources International Ltd.** and **Petromet Resources Ltd.** adjacent to the Colomac mine leases. They also completed geophysical surveys and drill programs on the mine leases.

CONTWOYTO - ITCHEN - POINT LAKES AREA

Exploration was for Lupin type gold deposits.

Joint venture partners **Cominco Ltd.**, operator, and **Cogema Canada Ltee.** explored the COCO claims (76 E/16) by mapping, prospecting and 100 line km of magnetometer and HLEM geophysical surveys. Fifteen holes (totalling 1200 m) were drilled, which intersected thin, low grade, auriferous iron formation (22, Fig. 3).

BHP-Mines Ltd. explored showings of auriferous iron formation by drilling 150 m on the TROY claims (76 E/13 & 14) and 365 m on the BRAD claims (23, Fig. 3; 76 E/13).

Echo Bay Mines Ltd. continued exploration of their Lupin Mine property (76 E/11). **MPH Consulting Ltd.** were contracted to conduct 450 line km of HLEM and magnetometer geophysical survey to help define iron formation. Mapping, sampling and prospecting together with 5000 m of drilling in 60 holes were also completed at a cost of $1 million (23, Fig. 3).

Cominco Ltd. explored the AUR 24 claim (76 E/10) for extensions to the Butterfly deposit, estimated at 100,000 t grading 17 g/t Au. Seven drill holes for 1200 m were completed. Claims are held under a joint venture with **Cogema Canada Ltee.** and **Aber Resources Ltd.** (24, Fig. 3).

On the REN claims (76 H/6 & 7), **Cominco Ltd.**, operator, and joint venture partner **Westview Resources Inc.** drilled 18 holes totalling 2396 m, to explore iron formations for gold. Six holes tested the Main zone and its north strike extension, two were drilled on the Banner zone and ten holes were drilled on nine EM conductors. A new discovery, the Grizz showing, tightly folded south plunging silicate and sulphide iron formation exposed across 34 m was channel sampled, trenched and tested by 3 holes. Intersections included 0.9 m grading 7.85 g/t Au. The Grizz showing is on strike with a conductor which may be the same iron formation as the Main showing. Mapping, sampling, prospecting and 150 line-km of HLEM and magnetometer surveys were completed. Expenditures are estimated at $750,000. Westview Resources Inc. reports that previous drilling in the Main zone indicates the potential for a 1.8 to 2.7 Mt deposit in the 10 g/t Au range within near vertically-dipping sedimentary-hosted iron formation (25, Fig. 3).

LAC DE GRAS

In the Exeter Lake area **Norm's Manufacturing and Geoservices Ltd.** were contracted to conduct soil sampling on the southern part of an enormous (60 x 30 km) claim block A, B, C and T (76 D/9, 10 & 11) covering supracrustals and granites It is anticipated ground geophysics will be conducted over the claims this winter (26, Fig. 3).

INDIAN MOUNTAIN LAKE

Exploration was for base metals.

On the AA and CC claims (75 M/2) **Cominco Ltd.** prospected and soil sampled for base metals in areas defined as conductors by a 1964 ground magnetometer and HLEM geophysical survey (27, Fig. 3).

Ego Resources Ltd. and **Asquith Resources Inc.** completed a 3300 m drill program in February 1990 to test the BB volcanogenic massive sulphide deposit (75 M/2). Drill intersections extended the strike of the southern limb of the BB deposit by 90 m and intersected copper-rich, stringer sulphide alteration up to 70 m thick 460 m west in the Kennedy Lake deposit. In August 1990 drilling resumed when financing, a private placement with Nanisivik Mines Ltd., was concluded and 19 holes, totalling approximately 3700 m, were completed. Exploration indicates that the BB deposit lies within the nose of a crescent shaped fold, plunging 45° north. A series of massive sulphide zones are hosted in laminated cherty tuff at the contact between footwall felsic volcanics and hanging wall quartz-mica schists or sediments. Drilling indicates that the deposit dips northeastward at -45° to 175 m level where it steepens to -65°. DDH E89-8 intersected 16 m of 16.7% Zn and 170 g/t Ag at the -300 m level. Previous reserves of the BB and Kennedy Lake deposits to the 350 m level are 1.4 Mt grading 10% combined zinc-lead, 137 to 171 g/t Ag and 0.7 g/t Au (27, Fig. 3). New reserves are being calculated.

YELLOWKNIFE SUPRACRUSTAL BASIN

Cameron-Beaulieu Rivers volcanic belt

Exploration was for gold and polymetallic volcanogenic massive sulphides.

Placer Dome Inc. completed mapping, litho-geochemical sampling, magnetometer, VLF, and IP geophysical surveys on the KA and PAM claims (85 P/1 & 8) optioned from **W. Kizam**. Exploration was for shear hosted gold deposits (28, Fig. 3).

BHP-Utah Mines Ltd. mapped and prospected their TOP claim (28, Fig. 3; 85 P/1).

Exploration by **Noranda Exploration Co. Ltd.** in the area of the Sunrise deposit (85 I/16), estimated at 1.8 Mt grading 8.9% Zn, 4.2% Pb, 405 g/t Ag and 1 g/t Au included drilling 5,000 m using 2 rigs to test for base metals up to 10 km south of the deposit. The $1.2 million expenditure was Noranda's largest in western Canada (29, Fig. 3). The claims were returned to **Aber Resources Ltd.** and **Hemisphere Development Corp.** in Fall 1990 when Noranda terminated an option agreement.

In the Turnback Lake area **Nanisivik Mines Ltd.** drilled 3000 m to explore the KIL, RHY, CJ and JAK claims (85 I/10,11), under option from **Aber Resources Ltd.** and **Kelmet Resources Ltd.**, for polymetallic volcanogenic massive sulphide deposits. The 20 drill targets tested included air and ground EM geophysical anomalies outlined during 1989 exploration (30, Fig. 3).

Pamorex Minerals Inc. drilled 14 holes, totalling 887 m, to explore for gold on the AP and RGE claims, part of the Myrt Lake property (85 I/14). Results were generally negative although anomalous gold values were reported from the Main zone (31, Fig. 3).

Yellowknife turbidite basin

Exploration was for turbidite - hosted quartz gold veins, with the exception of the Nicholas Lake deposit which is chiefly hosted in granodiorite.

In the Gordon Lake area under the management of **Cameron Mining Ltd.**, **New Era Development Ltd.** had a 1900 t bulk sample mined in February and March from the DAF deposit (85 I/14) and transported to Burnt Island. A 25 t/day mill was brought to site on the ice road in March. A 1000 t bulk sample was mined from Burnt Island on the GOO and CATHY claims (85 P/3) by a decline to the 155 m level. Between July 1 and September 19,2000 t of material, 50% from the 1989 bulk sample and 50% from the 1990 bulk sample, were hand picked and 1700 t were processed through the mill. Results are pending. It is anticipated that the bulk sample taken from the DAF (85 I/14) will be processed in 1991 (32, Fig. 3).

Roxwell Gold Mines Ltd. drilled 9 holes on a 10 m grid to confirm grade and continuity of the main vein and test the potential for a small open pit mine using custom milling on the TRY ME claims (85 P/3). Previous reserve estimates are 87,100 t grading 9.26 g/t Au (32, Fig. 3). The claims are optioned from **Cominco Ltd.**

Athabaska Gold Resources Ltd. and **Chevron Minerals Ltd.** drilled two deep holes and two shallow holes, totalling 1863 m, on the NIC claims (85 P/5). The two deep holes intersected extensions of the A-7 and A-6 veins between 385 m and 465 m below surface confirming the downward projection of the Main showing. These new intersections are about 150 m below the deepest ore grade intersection of the A-7 vein. DDH 69 intersected 3.9 m of 5.4 g/t Au including 1.1 m of 9.8 g/t Au. DDH 71 intersected 1.1 m of 76.4 g/t Au and 13.4 m of 2.4 g/t Au. Cost of 1990 exploration was $400,000. Studies by independent consultants indicate that a 400 t/day mining operation would be profitable. **Athabaska Gold Resources Ltd.** plan to mobilise equipment to the site this winter for a $3,000,000 underground bulk sample test of the Nicholas Lake deposit in 1991. The reserve, presently outlined by 69 ore grade intersections is 557,000 t grading 12.3 g/t Au (33, Fig. 3).

Treminco Resources Ltd. continued to explore their mine properties, the Tom and Ptarmigan by drilling (85 J/9). Ore grade drill intersections of the C vein will be explored from underground when drifting from the Tom mine to the C vein is completed in late 1990 (34, Fig. 3).

Yellowknife volcanic belt

Exploration was entirely for gold.

The 1989 bulk sample from the MON property (85 J/16), 2300 t estimated to grade 18.4 g/t Au was shipped by **Can-Mac Exploration Ltd.** to the Ptarmigan mill for processing. 1989 underground exploration showed the ore zone to be

24 m long over an average mining width of 3.1 m. The vein is well mineralized in the floor of the undercut. Head grade of the first 1015 t 5.5 g/t was below anticipated grades. Three holes for 100 m were drilled from underground (35, Fig. 3).

In the Walsh Lake area **W. Humphries** prospected and had mapping completed on showings on the SAM and EAGLE claims (36, Fig. 3; 85 J/9).

Kelmet Resources Ltd. continued exploration of the volcanic-sediment contact on the TING, WAL, EQUINOX, KELLY, DUCK, TORO and CADEN claims (85 J/9) by prospecting and sampling (36, Fig. 3).

Exploration of the volcanic-sediment contact by **Nathan Minerals Inc.** on the PRO and ANN claims (85 J/8 & 9) included drilling 7 holes which extended the mineralised zone 1 km south (36, Fig. 3).

Giant Yellowknife Mines Ltd. completed four deep exploration holes from surface on their mine property (85 J/8). Although shear zone structures were intersected gold values were low (36, Fig. 3).

NERCO Inc. aggressively explored their mine leases (85 J/8). Surface work included extensive mapping and geochemical sampling and drilling 3500 m at Rat Lake and 2000 m at Crank Lake to test the Con shear. Following an extensive IP survey south of the Robertson shaft 600 m were drilled at Negus Point to test the Campbell shear and 1000 m were drilled at Fault Lake to test the extension of the Campbell shear. The C16 and C20 shears were explored by trenching and channel sampling, mapping and magnetometer and VLF geophysical surveys (37, Fig. 3). Exploration expenditures are estimated at over $800,000.

Golden Marlin Resources Ltd. and joint venture partner **Cameco** conducted IP surveys and drilled 8 holes for 1300 m to explore for shear hosted gold on the MARLIN claims 85 J/8) covering Yellowknife Bay (37, Fig. 3). Drilling intersected the complex intrusive contact between volcanics and Western Granodiorite.

BEAR STRUCTURAL PROVINCE

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Cominco Ltd. prospected and mapped parts of Prospecting Permits 1244 to 1250 (86 F/2, east half; 86 F/8, east half; 86 F/15, northeast quadrant; and 86 G/4, west half) in the Bear Province or near the Bear-Slave boundary. Individual prospectors staked three groups of claims as follows: ARSENO 1-6, (86 B/12), Donald B. Cross; HORDEL 1, (86 F/12), D'Arcy Mercredi; and OLY 1-3, (86 F/12), David Smith.

GREAT SLAVE PLANE AND CORDILLERA

Dorothy Atkinson and W.A. Gibbins
NWT Geology Division, DIAND

BP Canada Inc. drilled several holes near the Horn Plateau (2, Fig. 4; 85 K & L), and staked additional claims. They also explored prospecting permits in the Greasy Lake area (1, Fig. 4; 95 J/16).

Cominco Ltd. did geophysical surveys of claims near Racoon Lake (3, Fig. 4; 85 K/13 & 14), Mink Lake (4, Fig. 4; 85 F/14), and Chedabucto Lake (5, Fig. 4; 85 J/5 & 6).

In the Cordillera, **Procan Exploration Co. Ltd.** conducted geochemical sampling of the RICO and PC claims (95 F/10) for polymetallic base metal deposits.

ARCTIC ISLANDS

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NWT Geology Division, DIAND

Nanisivik Mines Ltd. explored the Nanisivik Mine area with drilling and VLF-EM surveys (1, Fig. 5; 48 C/1).

In the Central Arctic, **Cominco Ltd.** did UTEM surveys and several thousand metres of drilling at the Truro Island

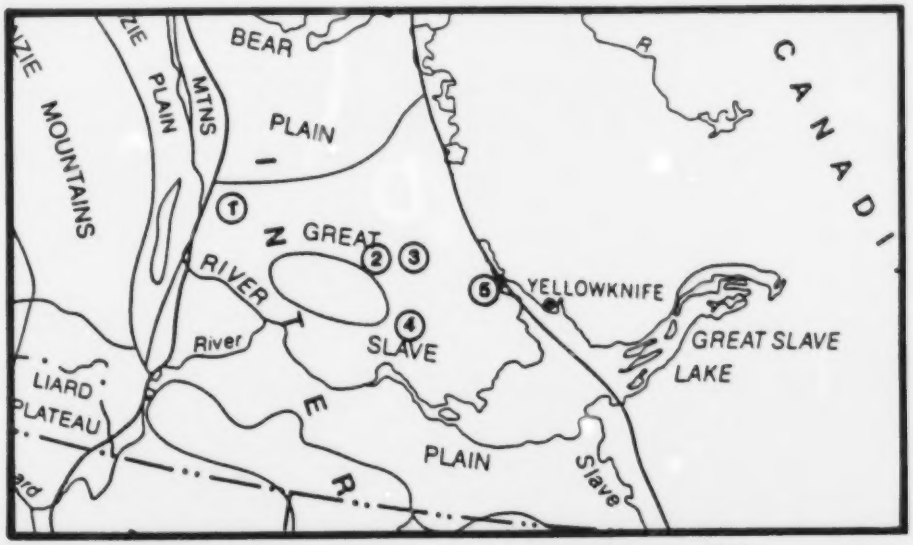

Figure 4: Mineral exploration in the Great Slave Plane area, 1990.

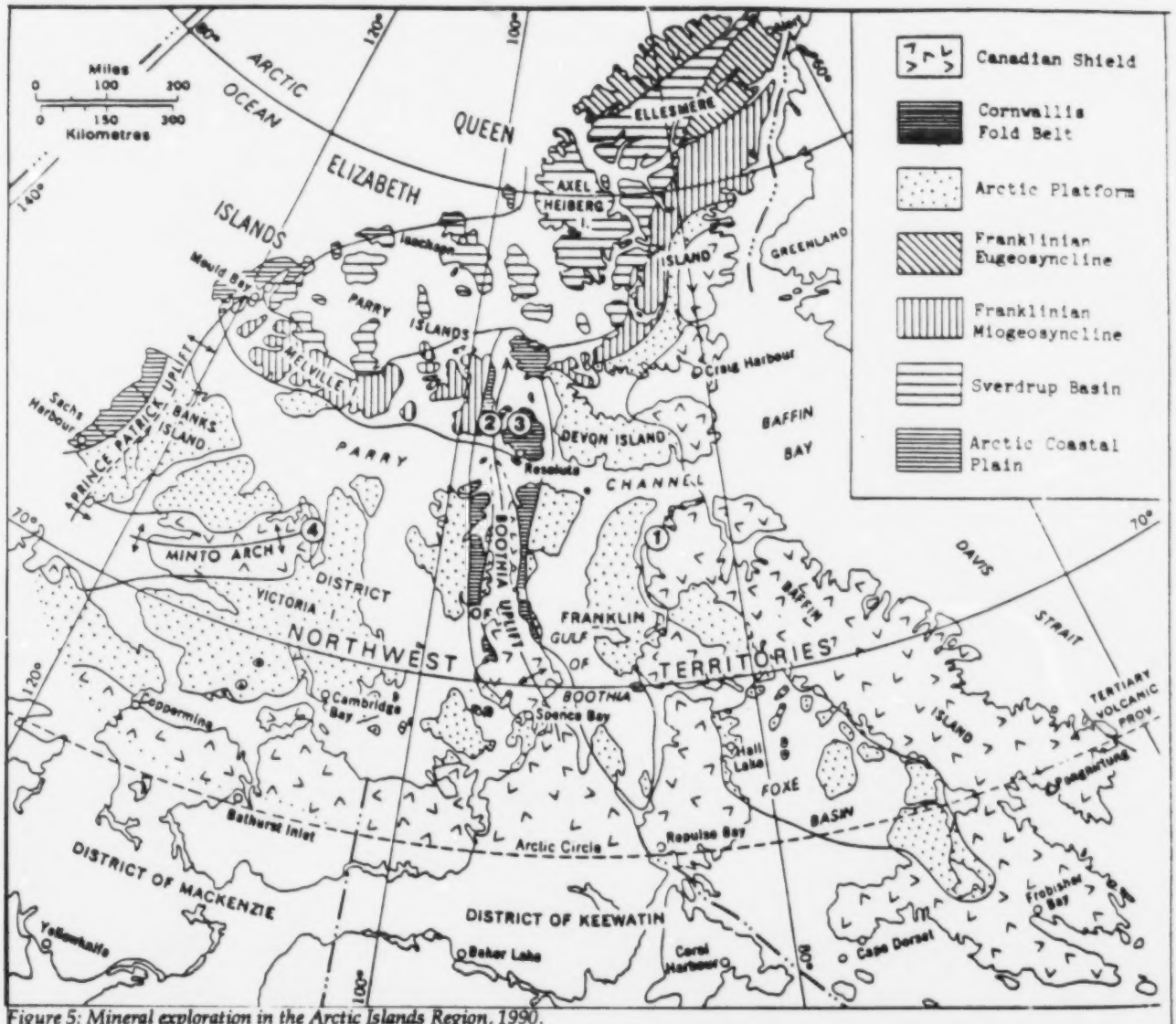

Figure 5: Mineral exploration in the Arctic Islands Region, 1990.

(68 H/2 & 7) and the Eclipse (68 H/9) deposits, northeastern Little Cornwallis Island (2, Fig. 5). **Cominco Ltd.** also staked favourable areas of northern Cornwallis Island (3, Fig. 5; 58 G).

Noranda Mines Ltd. staked a fairly large area of north-central Victoria Island (4, Fig. 5; 78 B).

SOUTHEAST MACKENZIE DISTRICT

S. P. Goff
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TALTSON ARC

Kelmet Resources Ltd. and **Prairie Cache Resources Ltd.** prospected the EIGHT, ONE THREE MINE and PROSPERITY claims in the Thubun Lakes area and mapped copper-zinc-silver-gold showings (1, Fig. 6; 75 E/12).

BHP-Utah Mines Ltd. mapped and sampled copper-nickel-gold-PGE showings in the Rutledge Lake area on the LEA claims, which were optioned from **Enexco International Ltd.** (2, Fig. 6; 75 E/10).

DISTRICT OF KEEWATIN

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GOLD

Asamera Minerals Inc., in a joint venture with **Comaplex Resources International Ltd.**, carried out detailed mapping and channel sampling plus magnetic and VLF surveys on the NAT claims, northeast of Rankin Inlet in the Meliadine River area. An east-west mineralized zone, 230 m long and open at both ends was channel sampled, the best intersection being 20.6 g/t over 8.2 m. Fourteen holes, totalling 1100 m, were drilled on this property. Mineralization was encountered in eleven holes, the best intersection being 12.4 g/t over 12.1 m.

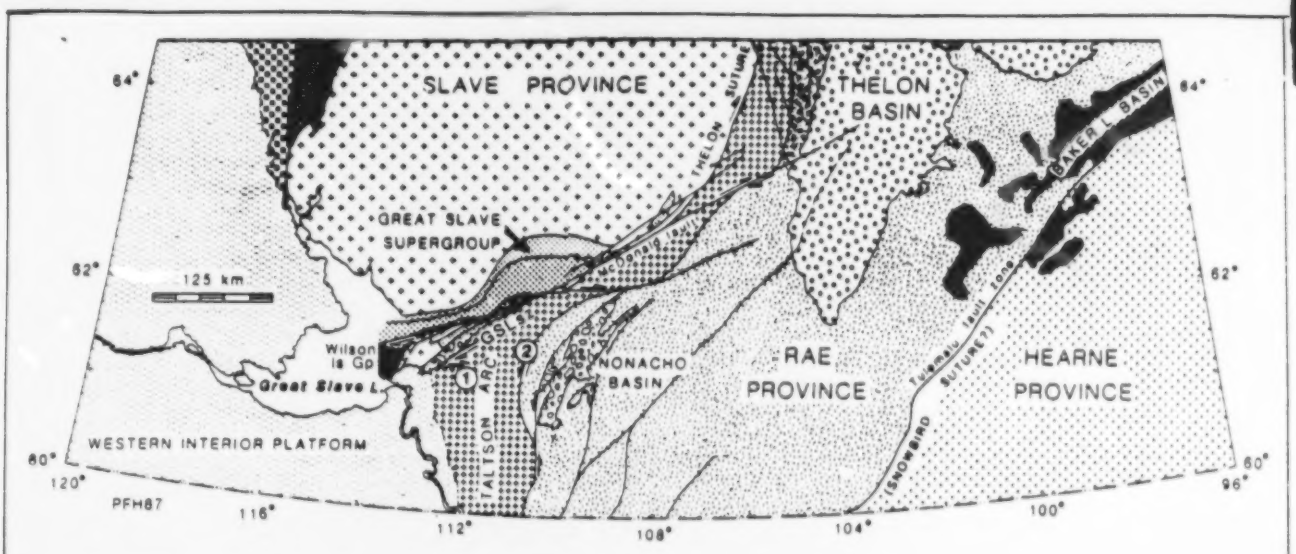

Figure 6: Mineral exploration in the Southeast Mackenzie District, 1990.

Prospecting and grab-sampling took place on the adjacent Prospecting Permits 1210 to 1224 (1, Fig. 7; 55 J,K,N & O).

BHP-Utah Mines Ltd. completed 3050 m of drilling on their claims at Carr Lake (7, Fig. 7; 55 L/4) and east of Maguse Lake (9, Fig. 7; 55 E/10).

Comaplex Resources International Ltd. prospected, mapped and sampled Prospecting Permits 1233 to 1237 and 1251 in the Cullaton Lake area (11, Fig. 7; 65 G & H).

Comaplex Resources International Ltd., on behalf of **Lucky Eagle Mines**, **Hecla MIning Company of Canada Ltd.** and **Agnico Eagle Mines Ltd.**, worked land at present held by **Comaplex Resources International Ltd.** and **Asamera Minerals Inc.** This work comprised VLF and magnetic surveys, structural mapping and 2600 m of diamond drilling on the Meadowbank River claims (22, Fig. 7; 66 H/1 & 7), plus prospecting on nearby Prospecting Permits 1206 to 1209 (22, Fig. 7; 66 H/7 & 8).

Dejour Mines Ltd. staked the MAC and PAD claim blocks in the Turquetil Lake area (8, Fig. 7; 65 H/16 & I/1).

INCO Exploration and Technical Services Inc. performed regional mapping, HLEM, IP and magnetic surveys on the IGLOO claims in the Dawson Inlet area (4, Fig. 7; 55 F/13).

On behalf of **Lucky Eagle Mines**, a joint venture of **Agnico Eagle Mines Ltd.** and **Hecla Mining Company of Canada Ltd.**, **W. A. Hubacheck Consultants Ltd.** conducted EM, VLF and magnetic surveys on gold and possible base metal targets on Prospecting Permits 1170 and 1171 in the Kasba Lake - Ennadai Lake area. The newly-staked WADE claim was mapped (15, Fig. 7; 65 C/12 & D/9).

Norstrat Exploration Inc. and **Acadia Mineral Ventures Ltd.** prospected and sampled the newly-staked KING claims in the Padlei area (10, Fig. 7; 65 H/15 & 16).

Suncor Inc. prospected, mapped and sampled Prospecting Permits 1229 to 1232 (12, Fig. 7; 65 G/2 & 7).

URANIUM AND OTHER COMMODITIES

Urangesellschaft (Canada) Ltd. in a joint venture with **PNC Exploration (Canada) Co. Ltd.** drilled a total of 6700 m on a lease and claim block in the Judge Sissons Lake - Schultz Lake area and carried out a mineral prospecting program on adjacent Prospecting Permits 1161 to 1163. Surface VLF, magnetic, resistivity and gravity surveys were performed on selected areas in permits, leases and claims (20, Fig. 7; 66 A/5, B/1 & B/8).

Urangesellschaft (Canada) Ltd. in July, requested the Federal Environmental Review Office Panel to delay indefinitely its planned environmental assessment hearing of the Kiggavik uranium mine project (21, Fig. 7; 66 A/5).

J. Antoshkiw of St. Malo, Manitoba, staked claims for base metals and gold just west of Rankin Inlet (2, Fig. 7; 55 K/16) and at Mistake Bay (3, Fig. 7; 55 K/2).

R. Major of Saskatoon staked claims in several localities: Copperneedle River (5, Fig. 7; 55 L), west of Kaminak Lake (6, Fig. 7; 55 L), Nueltin Lake (13 & 14, Fig. 7; 65 B), south of Angikuni Lake (16, Fig. 7; 65 G), west of Yathkyed Lake (17, Fig. 7; 65 J), Dubawnt Lake (18 & 19, Fig. 7; 65 M), Baker Lake to Judge Sissons Lake (23, Fig. 7; 66 A), Bissett Lake (24, Fig. 7; 55 M) and Chesterfield Inlet (25 & 26, Fig. 7; 55 N & O).

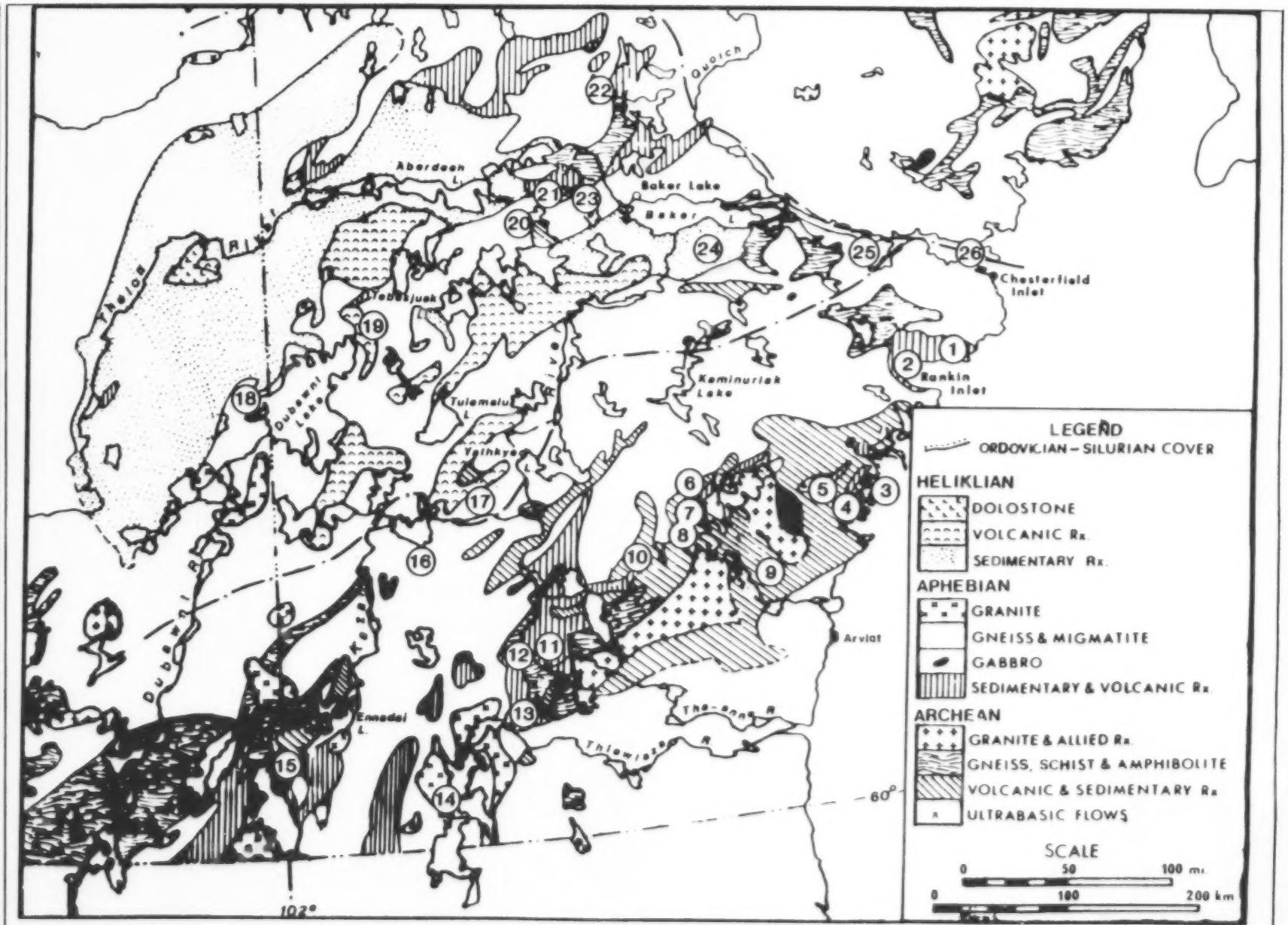

Figure 7: Mineral exploration in the Keewatin District, 1990.

PRELIMINARY REPORTS ON GEOLOGICAL WORK IN THE NWT

ABSTRACTS OF TALKS AND POSTERS AND SUMMARIES OF WORK IN PROGRESS

GEOLOGICAL AND GEOCHRONOLOGICAL CONSTRAINTS ON THE MAGMATIC EVOLUTION, DEFORMATION AND GOLD MINERALIZATION OF THE ANIALIK RIVER BATHOLITH AND ITS RELATIONSHIP TO THE ANIALIK RIVER GREENSTONE BELT, SLAVE PROVINCE (76 M/11)

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The Anialik River Batholith (ARB), located about 600 km north of Yellowknife, diapirically intrudes the Anialik River Greenstone Belt (ARGB). The ARB comprises a leucocratic, heterogeneously deformed hornblende-biotite tonalite with subordinate trondhjemite and minor mafic phases. Recent work has identified a relatively undeformed leucotonalite phase of the batholith and a mafic marginal phase (MMP) comprising heterogeneously deformed diorite, and gabbro along the western margin of the ARB.

The western ARB/ARGB contact is defined by a 200-800 m wide zone consisting of an east to west transition from weakly deformed tonalite and MMP rocks to mylonitized equivalents passing into highly strained metavolcanics. Felsic dykes (locally comprising approximately 80% of the width of this contact zone) intrude the host rocks subparallel to the foliation of this high strain zone, which is interpreted as a product of diapiric emplacement of the ARB.

Mafic and intermediate metavolcanics predominate in the southern portion of the ARGB, and felsic and subordinate intermediate metavolcanics predominate in the two northern arms of the belt. The ARB and ARGB are intruded by a post-tectonic quartz monzonite, the Chin Lake Stock.

Gold (860,000 tons grading 0.22 oz Au/ton) occurs within strongly to intensely foliated tonalite and MMP rocks of the western ARB. It is hosted predominantly by longitudinally extensive (up to 5 km) brittle/ductile shear zones over an approximately 4 x 8 km area. The S1 foliation in the ARB, interpreted as a product of diapiric emplacement is rotated into the mineralized shear zones. Gold-bearing shear zones thus postdate diapiric emplacement, but are crosscut by the Chin Lake Stock.

U-Pb zircon ages of 2694 +/-3 Ma and 2683 +/-2 Ma were determined on strongly deformed and relatively undeformed phases of the ARB, respectively. A quartz-feldspar porphyry from the ARGB gives a zircon age of 2678 +5/-4 Ma. The Chin Lake Stock gives an age of 2601 +6/-4 Ma by zircon and monazite. Titanites from five unmineralized samples of the ARB, representing a west to east traverse from the MMP to the Gray's Bay Shear Zone span a ca. ~11 Ma period of magmatic activity defined by the zircon ages for the oldest and youngest tonalites. The oldest tonalite sample forms the hanging wall to the North Central Vein, one of the most extensive mineralized shear zones in the ARB. Titanite from this sample is dated at 2670 Ma, the youngest titanite age obtained in the ARB. The lower Th/U ratio (0.003) of this titanite, compared to the Th/U ratios for titanites from samples outside mineralized shear zones (Th/U range 0.33-2.21), is indicative of formation by fluid dominated alteration or metamorphism in the shear zone.

These new ages support the work of others and demonstrate that the magmatic activity in the ARB and ARGB was coeval with similar Hackett River-type volcanoplutonic belts in the eastern Slave Province. The quartz-feldspar porphyry is coeval or slightly younger than the youngest tonalite and may possibly be comagmatic. The ARB was emplaced synvolcanically, and magmatic activity in the ARGB spanned an interval of at least 11 Ma. Gold mineralization within the ARB is bracketed by the emplacement ages of the youngest tonalite (2683 Ma) and the post-tectonic Chin Lake Stock (2601 Ma). This represents an ~80 Ma time span. The young titanite age dates hydrothermal alteration which may be associated with gold mineralization.

GEOLOGY AND PETROLOGY OF GOLD-BEARING IRON FORMATION IN THE THIRD PORTAGE LAKE AREA, KEEWATIN DISTRICT

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Archean (2.8 Ga) supracrustal rocks of the Woodburn Lake Group form a northeast-trending bimodal sequence of komatiitic-tholeiitic and calc-alkaline metavolcanic and related metasedimentary rocks 80 km north of Baker Lake, NWT. These rocks lie within the Rae Province of the Canadian Shield. In the Third Portage Lake area (66 H/1), mapping at a scale of 1:25,000 shows that these rocks are represented by a thick sequence of massive volcaniclastic rocks, abundant banded magnetite-chert iron formation (BIF), ultramafic to felsic volcanic rocks and younger quartzites. Meta-gabbro and serpentinite occur as sill-like bodies within the volcanic sequence. The above rocks have been intruded by late Archean (2.6 Ga) coarse grained granite plutons and an Aphebian (1.8 Ga) alkaline lamprophyre dyke (kersantite). Talc-tremolite-carbonate schists represent the ultramafic rocks; their geochemistry suggests a komatiitic affinity which is consistent with the presence of relatively unaltered komatiite flows 20-30 km north of the map area. Geochemistry of the volcaniclastic rocks suggests that they have a primary igneous source with calc-alkaline chemical affinities. In AFM space, the meta-gabbros plot in the tholeiitic field. Metamorphism has reached lower to middle greenschist facies; several phases of folding and faulting have deformed the rocks in this terrain.

A major feature in the study area is the presence of auriferous BIF which is the target of an extensive exploration program by Comaplex Mineral Corporation of Calgary. Mineralization is restricted to the BIF. In addition to gold, pyrrhotite, pyrite, and lesser amounts of arsenopyrite and chalcopyrite are observed. Grunerite is a common silicate phase in the mineralized BIF. The samples which contain mineralization have discontinuous, disrupted iron oxide-silicate bands. Ductile meso- and micro-shears containing sulphides, chlorite and grunerite are oriented nearly perpendicular to the original banding. As the degree of ductile deformation of the BIF increases, so does the grade of mineralization. Gold mineralization is associated with both pyrrhotite and pyrite. In the more ductile deformed zones pyrrhotite-magnetite +/- pyrite are common; auriferous pyrite zones are vuggy in appearance and may be related to a more brittle and later phase of deformation.

The rock units associated with the BIF in the mineralized zone on surface and in drill core include: chlorite-quartz schists (silicate facies iron formation); tremolite-chlorite-talc-carbonate schists (ultramafics); quartz-muscovite schists (felsic volcanics); and quartz-plagioclase-biotite-chlorite schists (volcaniclastic rocks). Potassic alteration (biotite) is associated with the mineralization and occurs as biotite porphyroblastic growths in narrow veins in the schists, and in the chlorite rich layers in the BIF. In quartz rich sequences adjacent to the mineralized BIF, fuchsite is abundant over 1-3 metre widths (drill core). Fuchsite in quartz veins also occurs in carbonatized mafic/ultramafic rocks in the western part of the study area.

AN EXPLORATION UPDATE ON THE GOLD POTENTIAL OF THE CON SHEAR SYSTEM, NERCO CON MINE, YELLOWKNIFE, NWT.

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Active mining and exploration within the Con Shear (85 J/8) ceased in the 1950's after producing 1,628,000 tons of refractory ore yielding 928,000 ounces of gold for an average grade of 0.57 oz/ton Au.

New exploration results indicate that abandonment of Con Shear ores in favour of the free-milling gold ore of the Campbell Shear left considerable potential for delineating further reserves. Approximately 6,500 metres of surface drilling has been carried out over the past year. Cored intersections, ranging from 1.75 to 15 metres true width and grading from 6 to 10 g/t Au, indicate that well mineralized shear-domains occur at shallow levels.

The Con System is comprised of anastomosing, north to northeast trending, moderately west-dipping reverse shears. The system has been explored for a strike length of over 5 kilometres and locally to a maximum vertical depth of 850 metres. Shearing is broadly coincident with the outer limit of a regional hornblende-amphibolite metamorphic aureole to the Western Granodiorite. The hornblende-amphibolite facies hanging wall and epidote-amphibolite facies footwall volcanic sequences are lithologically similar. Both consist of 050°-060° trending, southeast facing, and steeply (70°) southeast dipping pillowed to massive basaltic flows interlayered with minor pillow breccia and cherty-tuff units. Both hanging wall and footwall sequences are intruded by multiple gabbroic dykes and numerous granitic plugs that pre-date the shearing. The shears are in turn crosscut by Proterozoic diabase dikes.

Retrogression of the hanging wall hornblende-amphibolite facies volcanics to a calcite-epidote-quartz-chlorite assemblage intensifies with increased jointing within 5-10 metres of the shear contact. On the immediate hanging wall, calcite cements strongly bleached joint breccia. These marginal joint breccias become progressively foliated and within 1-2 metres of the shear contact there is a sharp transition from calcite to ankerite bearing sericite-quartz-chlorite schist. This alteration assemblage envelopes weakly to non-foliated calcite and chlorite-altered volcanic domains within the zone of shearing.

Two types of gold ore are observed: i) high grade (10 g/t Au) 2-3 metre wide zones of quartz-sericite-ankerite-pyrite-arsenopyrite schist with metre wide blue-grey quartz veining within thin (3-3.5 metre) wide shear strands; and ii) low grade (5-6 g/t Au) 10-15 metre wide laminated quartz-sericite-ankerite-pyrite-arsenopyrite bands generally devoid of quartz veins within thick (30-35 metre) shear strands. Both types of gold mineralization tend to be situated in flexures of the shear that trend 025°-030°. The more northerly-trending segments of given shears are comprised of non-auriferous chlorite-ankerite schists. Shear flexures are the result of anisotropies between pillowed and massive flow units and the crosscutting joint/shear sets. Gold is closely associated with sulphides: pyrite + arsenopyrite> chalcopyrite sulphosalts sphalerite pyrrhotite. Free gold is common in high grade veins where it occurs along microfractures and along grain boundaries of arsenopyrite and pyrite. Refractory gold is bound in arsenopyrite.

A preliminary interpretation is that the Con Shear System is a retrogressed fluid front that follows a regional hornblende/epidote metamorphic isograd. The deformation progressed through early ductile and late brittle stages with gold concentration occurring

over a protracted time period. Strands of the Con Shear System persist through Meg Lake into the Octopus Lake area south of the NERCO Con mine. Gold potential of this major shear system has not yet been delineated in any detail either along strike or in its down-dip extension.

ECONOMIC SIGNIFICANCE OF HOT SPRING CHERTS: THE HAWK HILL MEMBER (EARLY PROTEROZOIC KURWITZ GROUP), DISTRICT OF KEEWATIN (65 G/2&7)

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Contrary to previous interpretations, bedded white chert, iron-oxide-rich maroon chert, and chert breccias that lie conformably between Whiterock Member quartz arenites and Ameto Formation mudrocks are not siliceous paleosols (silcretes) but sinter deposits formed by surface discharging of silica-enriched hot springs, a lithofacies with few well-documented ancient examples. Basement fracturing (of uncertain origin) provided conduits for efficient fluid and convective heat transfer to the surface, and hot spring development. Amorphous silica (neomorphosed to micro-

quartz) accumulated on sporadically distributed, topographically elevated sinter fans of limited extent, reaching thicknesses of up to 23 metres. Asymmetric iron-rich to silica-rich microbands represent the sequence of precipitation from discrete iron and silica laden hydrothermal pulses. Breccias were formed by dehydration-induced soft sediment deformation, surface reworking, and hydrothermal eruption. Fluidized ascending waters reworked partially cemented Whiterock Member quartz sands to deposit single grains within chert, and cleared bottlenecks in the underlying plumbing system (created by subsurface veining) to yield local megaquartz-adularia clasts within breccias.

Recognition of the Hawk Hill Member as a sinter deposit opens a new exploration target, in both basement and Proterozoic rocks, that may be added to previously defined structure-controlled models: hot spring gold. Major element compositions of the Member are comparable to other sinters but trace elements differ, lacking enrichment in Au, Ag, As, Sb and Ba. Barren sinter caps above hot spring ore bodies are not unusual. Although apparently barren of precious metals, the unit marks sites of hydrothermal processes that may have concentrated precious metals in subjacent units. Slightly elevated gold values were found in bedding-discordant crackle breccias (quartz arenite fragments separated by hematite-filled hairline fractures) within the Whiterock Member (subsurface feeders?, 11-460 ppb) and in lowermost ferruginous Ameto Formation mudrocks (8-25 ppb).

GEOLOGY OF THE WESTERN PLUTONIC COMPLEX, SOUTHWESTERN SLAVE PROVINCE: LATE ARCHEAN CRUSTAL GRANITES AND GOLD MINERALIZATION IN THE YELLOWKNIFE DISTRICT

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Regional scale (1:50,000) mapping, geochemistry and geochronology has redefined the Western Plutonic Complex (85 J) into five distinct terrains of decreasing age including: (1) metaluminous tonalite-amphibolite-gneiss (2) gabbro-tonalite-granodiorite (3) trondhjemite-granodiorite-granite (4) peraluminous granite plus aplite-pegmatite-quartz veins and (5) alkali metasomatised tonalite-amphibolite. The terrains modify subdivision of Plutonic Suites formerly recognized by Henderson, 1985.

(1) **Anton Complex:** early metaluminous tonalite-amphibolite-gneiss forms a broad belt of rocks formerly mapped as portions of Anton Complex, Stagg and Awry Plutonic Suites. The rocks are a very strongly deformed, metamorphosed, variably alkali-metasomatised, heterogenous terrain containing many inclusions of orthogneiss. The complex displays continuous geochemical variation between two end members including: 1) metagabbro-metagranodiorite with typical Archean volcanic arc tonalite, trondhjemite, granodiorite (TTG) geochemistry including low Rb/Sr, LREE enrichment, HREE depletion, normative diopside to corundum, and trondhjemitic to calcalkaline trends and 2) alkali metasomatised deformed metaplutonic and gneissic phases (syenogranite gneiss) with strong LIL, LREE and HREE enrichments, and normative corundum.

(2) **Defeat Suite (lower):** coarse grained moderately to strongly deformed, heterogenous, variably contaminated tonalite-granodiorite, layered hornblende gabbro and diorite forms a broad belt of rocks along the eastern edge of the Western Plutonic Complex. The terrain includes most of the Defeat Suite and portions of rocks formerly mapped as Anton Complex. A U/Pb isochron on zircon from granodiorite from the western edge of the suite returned an upper intercept age of 2634 +/-5 Ma, however, a lower intercept age of 1226 Ma is considered high and the rocks are considered younger than 2634 Ma.

(3) **Defeat Suite (upper):** small fine to medium grained, massive to foliated, homogenous, porphyritic biotite trondhjemite-granodiorite-granite plutons are concentrated along the eastern edge of the Western Plutonic Complex and locally intrude the Yellowknife greenstone belt. They are compositionally and texturally equivalent to many plutonic lobes of the Southeastern Granodiorite and represent the late uppermost plutonic level of the Defeat Suite (2). U/Pb investigations on zircons from granodiorite indicate the plutons are full of inheritance and did not return a useable isochron. Previous U/Pb age determinations (Henderson, *et al.*, 1987) on equivalent phases of lower and upper Defeat rocks mapped during this study, represent the main event of Defeat Plutonism at ~ 2620 Ma. Defeat Suite rocks (1), (2) are geochemically similar to metaluminous arc related TTG phases of the Anton Complex with distinct trondhjemitic trends in the upper suite and consistent with derivation from partial melting of garnet amphibolite followed by fractional crystallization producing diorite through granite compositions.

(4) **Awry Complex:** a dominantly peraluminous granitic terrain west of the Anton Complex includes most of the Awry Plutonic Suite and portions of the Stagg Plutonic Suite. Massive to foliated, homogenous biotite +/- muscovite leucogranite is the dominant lithology within the variably contaminated terrain containing many inclusions of paragneiss. U/Pb investigations on zircons from the leucogranite returned very discordant data, however a late Archean age similar to Stagg and Duckfish Granite is suggested, based on two zircon fractions and field relations. Geochemically the Awry rocks are significantly enriched in radiogenic heat producing elements (K-U-Th) and Rb/Sr, moderately enriched in LREE and HREE, and strongly corundum normative. The Awry Complex is a minimum melt leucogranite derived from basement paragneiss and is essentially the peraluminous complement to the metaluminous basement orthogneiss of the Anton Complex.

(5) **Duckfish-Stagg Granite:** Duckfish Granite and portions of the Stagg Plutonic Suite represent strongly alkali metasomatised tonalites of the early arc terrain (Anton Complex) which moved bodily away from their source as melt + restite, The Duckfish Granite underwent low degrees of fractionation as it was emplaced into higher levels of block-faulted crust. The Stagg and Duckfish Granites are clearly Archean in age and returned U/Pb zircon ages of 2589 +11/-9 Ma and 2584 +/-4 Ma respectively. Geochemically they are similar to enriched syenegranite gneiss of the Anton Complex.

The late Archean granites (4), (5) document a major crustal melting episode during final basin closure. Crustal melting

was assisted by mafic magmatism (synplutonic mafic diking, underplating?), and a source anomalously enriched in radiogenic heat producing elements (K-U-Th). The granites are linked spatially and temporally. Syncollisional peraluminous granites metasomatised overlying (thrusted) metaluminous terrain (1). The metasomatised granites (5) locally moved to higher crustal levels block faulted by the crustal melting - thermal doming event (~2585 Ma). These granites carry I and S - type chemical signatures from two different sources.

Granitic lenses conformable in the root zones of the Awry Complex are traced upward through the overlying granite - greenstone terrain as increasingly discordant dikes. The dikes and veins cut hornfelsed metamorphic aureoles through to the brittle-ductile transition zone and experienced increasing degrees of separation (zoning) of granitic and quartz vein + sulphide components with structural level. The veins are As-Au-Cu-Mo-Pb-Sb-Zn mineralized and associated with all the gold showings in the Yellowknife greenstone belt. Similarly, anatectic basement derived Prosperous Granite dikes and quartz veins (excluding late rare element enriched pegmatites) are associated with all the turbidite-hosted gold showing in the metasedimentary basins. In contrast, classic QFP dikes and stocks (Pud, Negus, Stock Lake (-2620 Ma) predate final basin closure, are volcanic arc TTG related, less commonly associated with gold showings, significant to metamorphic hardening (hornfelsing), and served as competent hosts to the late Archean granitic dikes and mineralized quartz veins. The emplacement of the late Archean granite induced further uplift, shearing and retrogression of the granite - greenstone pile, and accounts for shear zones cutting the marginal phases of the Western batholith as well as renewed activity along earlier shear zones in the main greenstone shear complex.

The major lode gold episode is a **Late Archean** event, ~2585 Ma correlated with anatectic granite derived from sialic basement during final basin closure.

ARCHEAN POLYMETALLIC VOLCANOGENIC MASSIVE SULPHIDE DEPOSITS WITHIN THE CAMERON AND BEAULIEU VOLCANIC BELTS SOUTH OF 63 N (85 I)

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Yellowknife, NT

Both eruptive style and chemical composition of the Archean Cameron and Beaulieu River volcanic belts evolved during their deposition. Early voluminous fissure eruptions of mafic pillow lavas and volcaniclastics were superseded by central eruptions of felsic lavas and pyroclastics. Felsic centres built emergent piles and culminated with explosive activity and emplacement of rhyolite domes. These centres (eg. Turnback Lake) were flanked by lateral and progressively upward fining sequences of distal volcanics and volcaniclastic sediments of felsic provenance and overlying Burwash Formation mudstone-greywacke turbidites.

Numerous concordant, polymetallic massive sulphide lenses are within rocks of the Cameron and Beaulieu River volcanic belts. Stratabound gossans, developed on the weathered outcrops of these lenses, have been explored since the 1930s. Recent exploration continues with emphasis on geophysical surveys which successfully define conductors that may or may not have magnetic response. Drilling in 1987, to test one such conductor, found the Sunrise deposit which has geologic reserves of 1.87 Mt of 13% combined Zn-Pb, 404.6 g/t Ag and 0.96 g/t Au.

Massive sulphide lenses occur within a variety of geologic settings: proximal felsic pyroclastics flanking rhyolite domes (eg. Sunrise and M zone, BEAR claims); distal volcaniclastic sediments (eg. LEN or EMILY showings on Victory Lake); at the transition between volcanics and overlying Burwash sediments (eg. OK and XL deposits on Turnback Lake); and within sediments (PAY showings). Numerous carbonate units in diverse settings are recognised within the Cameron and Beaulieu River volcanic belts and commonly are associated with massive sulphides as are cherts, argillites and graphitic argillites. Many carbonates and cherts are finely laminated sulphide-bearing exhalites which form impressive although barren gossans at several stratigraphic levels. Other carbonate units are thought to represent volcanic rocks which have been intensely carbonatized during volcanism. Alteration types associated with massive sulphides include bleaching, silicification, sericitization, carbonitization and chloritization.

The Cameron and Beaulieu volcanic belts wrap around extensive granitic and gneissic complexes that are in part basement (Sleepy Dragon Complex) and also around younger granitic to tonalitic plutons (eg. Redout Granite at Turnback Lake and Defeat Plutonic Suite at Tumpline Lake). Within the contact metamorphic aureoles of these plutons, mineralogy, texture and alteration assemblages of showings are overprinted and many of these deposits have been described as vein or replacement type. However, the proximity of these showings to felsic volcanics and the lateral continuity of mineralization along strike suggest a volcanogenic exhalative source.

Textures within massive sulphide lenses vary from fine grained and well banded to coarse grained and massive. The most common minerals are sphalerite, galena, chalcopyrite, pyrite, pyrrhotite and arsenopyrite. Silver content is typically high. Vertical and lateral mineral zoning within and adjacent to the lens is observed.

ARCHAEAN MAGMATISM

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Igneous rock compositions depend on both the tectonic processes and thermal state within their source regions. Much tectonic interpretation of older terrains is based on magmatic rocks because igneous rocks form a major and distinctive component of the geological record. Interpretation is often by direct analogy to present-day environments but a secular evolution of magmatic processes is to be expected as global tectonic processes will vary with cooling interior temperatures. The antiquity of the well preserved Archaean magmatic record (4.0 to 2.5 Ga) should allow delineation of the secular evolution. Here I review such secular changes and, using recent advances in modelling the physical processes which control melting and melt extraction (11,12,10,14), examine how the changes may be related to a hotter earth.

The most striking feature of Archaean magmatic sequences is their compositional and petrological similarity to modern igneous rocks. The distinctive features of Archaean igneous rocks include 1) the presence of komatiitic rocks derived from high-temperature liquids with 20% MgO, 2) calc-alkali suites characterised by higher Ni and Cr contents and highly fractionated REE contents with low heavy rare-earth element concentrations (although equivalents are found in modern suites), 3) the lack of undisputed mid-ocean ridge basalts (MORB) and 4) the lack or paucity of alkali and alkaline volcanics and plutonics.

The presence of komatiites and the paucity of alkali-rich magmas are taken as evidence for higher temperature source regions and higher degrees of melting. The lack of well developed ophiolite sequences of presumed oceanic crustal derivation in Archaean terrains may be a function of preservation (ophiolites are rare prior to the Mesozoic), a fundamental difference in their structure or the non-existence of Archaean oceanic crust. Thin komatiite-dominated sequences have been likened to ophiolites (6) as has a thick basalt and gabbro sequence with extensive mafic dyking (9). Neither of these examples has the cumulate, 100% dyke and pillow lava bearing sediment-free stratigraphy distinctive of ophiolites and thought characteristic of oceanic crust. The causes of the limited secular changes in calc-alkali rock compositions are more enigmatic, not least because the petrogenetic processes which control modern calc-alkali compositions are not well constrained.

Physical modelling of magma production allows derivation of a relation between magmatic products and source conditions. Melting related to adiabatic upwelling consequent on lithospheric extension is relatively well understood (14). Melting in such environments will be adiabatic because upwelling rates are much faster than conductive cooling from the surface. Melt volumes may be calculated as a function of mantle source temperature and amount of upwelling, given that basic, picritic and alkali melts separate from sources at relatively low melt fractions (12). Parameterization of available experimental melting data allows calculation of melt major-element compositions as a function of pressure and temperature for a dry model peridotite source. The results of this modelling successfully predict oceanic crustal composition. The compositional and geophysical variations in oceanic crustal structure are plausibly related directly to underlying mantle temperature (10). Extension of this model has important implications for Archaean tectonics (3). From theoretical and observational evidence (17, 2) Archaean mantle temperatures are estimated to have been 200°C to 400°C hotter than today. In such an environment mid-ocean ridge spreading would produce an oceanic crust in excess of 20 km thick of an average komatiitic basalt composition. This would have important implications for global heat loss processes and stabilization of the lithosphere. Melting would initiate at depths of up to 200 km compared to ca. 50 km in average temperature mantle today and advection of heat by melting would have been a significant heat loss process. Mantle temperatures must have been limited to less than 400°C hotter than today by the onset of copious melting. Deep melting would have formed a thick chemically depleted lithosphere which preserves diamonds at depths of ca. 200 km under present day Archaean cratons (16). The higher mantle temperatures would also have lead to significant melting associated with extensions of continental lithosphere and it is notable that most Archaean supracrustal sequences are volcanic-dominated.

More problematic aspects of Archaean magmatism relate to the depth and physical conditions responsible for the generation and chemistry of komatiites (3). Estimates of their maximum MgO contents rage from 25% MgO, 1500°C (7), through 30% MgO, 1590°C (2) to 33% MgO at 1650°C (8. Adiabatic upwelling of mantle with a potential temperature of 1650°C would produce a 24% MgO magma at 1480°C. Magmas with higher temperatures and higher MgO contents could be produced if lower degree, but highly magnesian melts, separated at depths of 150 to 200 km, and rose to the surface with limited further interaction with the solid mantle. Such melts should be more enriched in incompatible element concentrations than is observed in komatiites. Average mantle potential temperatures in excess of 1650°C would be precluded by the cooling arising from the copious melting down to the ca. 400 km depth of the olivine spinel-structure phase change as the slope of the solidus becomes less than that of the solid adiabat below about 8 GPa. With such mantle temperatures "magma oceans" may have been stabilized as a consequence of the density cross-over between melt and solid if melts were generated at depths in excess of 300 km (1).

Calc-alkali provinces are the other globally important magmatic environment. Melting below Archaean calc-alkali magmatic provinces, with OH-bearing phenocrysts and explosive eruptive styles, was probably initiated by hydrous fluxing of mantle source regions in a similar manner to present day subduction-related counterparts. Addition of 2% H_2O to a 1280°C potential temperature mantle would produce ca. 20% of a 1200°C potential temperature melt whereas 2% water added to a ca. 1580°C mantle would produce ca. 35% of a 1430°C potential temperature of komatiitic hydrous melt. The high Ni and Cr contents of most Archaean calc-alkaline magmas may be a function of source temperature. For example Ni partition coefficients decrease with increasing temperature. The origin of the other distinctive characteristic of Archaean calc-alkaline rocks, the fractionated REE Patterns is uncertain. The incompatible elements may be transported in hydrous fluid released from subduction zones, by small (0.1%) melt fractions, or may be enriched by remelting in crustal environments. Despite a number of detailed geochemical and isotopic studies, crust-mantle magmatic systems are too complex for unambiguous interpretation of their petrogenesis (eg. 18). Recent work on melt-crystal geometries at textural equilibrium (4) and calculation of minimum-melt fractions capable of separating from a solid matrix have emphasised the probability that the incompatible trace-element contents of magmas are controlled by addition of volatile-fluxed alkali-rich small melt fractions (13) (mantle metasomatism in geochemical parlance). The significance of this is that incompatible element signatures, for example the extreme REE fractionation characteristic of equilibrium with garnet, may be derived from source regions separated from those in which most of the melting and the major element compositions are established.

An understanding of the Archaean magmatic record depends on an uncertain interpretation of the present-day processes. The first-order secular variation in global magmatism is consistent with a hotter Archaean Earth but the complexities of melting environments, particularly those

producing calc-alkaline rocks, frustrate tectonic interpretations of older magmatic provinces.

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SATELLITE GEOLOGICAL MAPPING OF THE YELLOWKNIFE VOLCANIC BELT

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An Aries III Image Analysis System was used to manipulate LANDSAT 5 Thematic Mapper (TM) imagery of the Yellowknife Volcanic Belt (YVB) to ascertain if useful geological information could be generated using remotely-sensed data from a boreal region characterized by subdued relief, open-canopy forest cover, and about 50% outcrop exposure. The YVB was selected for study because detailed geological mapping is available against which computer-generated imagery could be compared and evaluated.

The study area (within 85 J/8 & 9) encompasses a northerly-trending belt of principally mafic volcanic rocks (Kam Group) flanked to the west by a multi-phase batholith (Western Granodiorite Batholith) and to the east by turbiditic sediments (Burwash Formation) and granitic stocks. Intermediate volcanic rocks of the Banting Formation form a relatively narrow belt separating the Kam Group from the Burwash Formation. Important gold deposits (Nerco-Con Mine, Giant Mine) are situated within the Kam Group, and smaller gold deposits have been exploited in the Burwash Formation.

Initially, images from each of the six TM channels were analyzed to identify those that best enhanced geological features. It was found that a combination of channels 7 (short-wave infrared), 3 (red) and 2 (green) produced the best discrimination of geological features. Various computer-generated enhancement programs were applied to refine the images obtained from these three channels.

In the enhanced images, at least three phases of igneous intrusions can be identified, as well as the boundaries of the Kam Formation, the boundaries of the combined Burwash-Banting Formations, and a number of important structural discontinuities. In addition, at least two alteration zones not noted on published geological maps were identified. It is concluded that computer analysis of satellite imagery has clearly useful geological applications in terrain similar to that of the study area.

TEMPORAL AND STRUCTURAL CONTROLS ON GOLD MINERALIZATION RUTH MINE PROPERTY, N.W.T.

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The Ruth property (85 I/7) is 96 km east of Yellowknife and consists of several thousand acres of staked and leased ground underlain by greenschist-grade turbidites of the Burwash Formation. The main prospect on the property is the Number 2 Vein: a bedding-parallel vein on the east limb of a major F1 structure, the Ruth Anticline. The vein is, on average, only 10-20 cm wide, but yields consistent multi-ounce gold assays over a strike length of about 90 m. Initially staked in 1940, the Number 2 Vein saw limited production in the 1940's (Cominco) and again in the 1950's (Ruth Gold Mines). In all, about 31 kg of gold was extracted from 370 tonnes of ore. Drilling and trenching suggest reserves of 2300 vein tonnes grading 71 ppm gold to the 60-m level, although a few deeper holes confirm that the zone is open at depth.

It has been known for some time that there are other gold-bearing veins, less consistently mineralized, lying parallel to and immediately north of the Number 2 Vein, but recent exploration has uncovered new showings several hundred meters to the south. These consist of quartz veinlets, only a few cm wide, which occasionally carry spectacular, cm-size gold nuggets as well as coarse clots of galena and sphalerite. In contrast to the northern showings, these veins crosscut bedding at a high angle, but are comparable in that they are associated with arsenopyrite-bearing, silicified wallrocks that carry up to 8 ppm gold.

Regional mapping suggests that gold mineralization is structurally related to the Ruth Anticline and is temporally related to the intrusion of later quartz-feldspar-porphyry (QFP) sills and dikes. To the south of the newly discovered showings, a zone of QFPs coincides with the axial trace of the Ruth Anticline for a strike length of at least 1 km. The QFPs carry arsenopyrite and are thought to be responsible for imposing an alteration halo of silicification and arsenopyritization on the adjacent metasediments. Both the QFPs and the altered metasediments, which can extend up to 30 m away from QFP contacts, are geochemically anomalous with respect to gold (mean: 90 ppb; maximums: up to several ppm).

In the vicinity of the newly discovered showings, the QFP zone breaches the axial trace of the Ruth Anticline and shifts eastward into the east limb of the fold. Thus, the QFP intrusions postdate the Ruth Anticline. All significant (8ppm) gold showings found on the property to date are within a narrow wedge bounded to the west by the axial trace of the anticline and to the east by the zone of QFP intrusions. The strike length of this favourable terrain is in excess of 1 km.

Considering only the Number 2 Vein, which is parallel to bedding and is folded by F1, it is tempting to speculate that the gold mineralization is an early event, either pre- to syn-D1. However, the regional picture suggests that gold is genetically related to QFP intrusions that clearly postdate D1. Moreover, the newly discovered gold showings are in veins that not only cut bedding, but also cut across and appear to be undeformed by a pervasive foliation (S2) that postdates D1. However, a subsequent foliation (S3), observed locally on the east limb of the Ruth Anticline, could actually be seen crenulating a seam of gold in one exceptionally rich sample from the Number 2 Vein, suggesting that at least one structural event postdated gold mineralization.

In summary, observations at Ruth suggest that although gold mineralization was a relatively late event in the deformational history of the area, it nevertheless appears to have been controlled by earlier structures.

GEOLOGY OF THE LUPIN DEPOSIT, NWT

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The Lupin gold deposit (76 E/14), 400 km northeast of Yellowknife, is in an Archean turbidite sequence, is stratabound and is confined to an amphibolitic iron formation which has been deformed several times. Gold is associated with sulphides within the iron formation and the sulphides are in turn related to a pervasive quartz veining within the iron formation. Quartz veins are predominantly northeasterly striking with subvertical dips. Because of the high density of veining in the main ore zones and the degree to which sulphides (especially pyrrhotite) are dispersed away from the veins, the relationship between sulphides and veining is not readily seen in well mineralized zones. It is only in the poorly mineralized portions of the iron formation, or at the margins of mineralized "shoots", where the vein/sulphide relationships can be clearly observed.

Mineralization is interpreted to be contemporaneous with D_{NE}-D_{NW} deformation. This event is thought to be post-peak regional metamorphism and possibly to be contemporaneous with one of the later stages of plutonism. The deposit is therefore probably not a syngenetic gold deposit but one which results from mineralization of a chemically and physically favourable host rock by solutions carrying Au, Fe, As, S, W, Cu and Ca. These solutions were channelled along openings created in the iron formation by brittle failure during D_{NE}-D_{NW} deformation. The provenance of these solutions is not known; they may be metasomatic fluids generated within the sedimentary pile during deformation and metamorphism or they may be related to one of the later plutonic events. Lupin is therefore probably related to the broad classification of deposits known as "turbidite-hosted gold deposits".

THE GEOLOGY OF PETROLEUM RESERVOIRS OF THE N.W.T.

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The Northwest Territories can be divided into three broad oil and gas regions: the Mackenzie Corridor; the Mackenzie Delta/Beaufort Sea; and the Arctic Islands. The combined potential reserves for these areas rival those of Western Canada and represent a total of 19 billion barrels of oil and 196 trillion cubic feet of gas.

In the Mackenzie Corridor prospects are targeted at Devonian carbonates in north trending anticlines. The major structural influence in the area was the Mesozoic Laramide orogeny. Significant production of oil and gas has been ongoing since the 1940's.

The Mackenzie Delta area represents a classic lobate deltaic sequence with five identified transgressive/regressive cycles. Clean stacked sands of Eocene to Paleocene ages provide competent reservoirs. A high concentration of listric down to basin growth faulting formed in response to Tertiary subsidence and has divided the anticlinal traps into numerous small pools.

The Beaufort Sea play-groups involve a deep water submarine fan situated on the edge of the Canada basin. The traps are formed by structural drape over shale diapirs and the reservoirs are contained within Paleogene turbidites.

In the Arctic Islands hydrocarbon exploration has proven most productive in the Arctic Fold Belt region. Structures formed in response to the Ellesmerian orogeny. Basal detachment of the Devonian strata combined with the mobilization of salts has resulted in the formation of north trending anticlines. Oil has been produced from this region since the 1980's.

GEOLOGY AND GOLD MINERALIZATION ON THE ASAMERA/COMAPLEX MELIADINE PROJECT, RANKIN INLET AREA, N.W.T.

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Gold mineralization associated with iron formation was discovered in the Meliadine Lake area (55 J/13), 18 km north of Rankin Inlet, N.W.T. in September 1989, by prospectors evaluating gold occurrences and linear magnetic features outlined by G.S.C. airborne magnetic surveys. In 1990, land acquisition was completed and an exploration program was initiated to evaluate the extent of the gold mineralization.

The rocks in this area belong to the Kaminak Group which is part of the Archean-aged Rankin-Ennadai Greenstone belt within the Churchill Structural Province of the Canadian Shield.

The iron formations are within an east-west trending, north dipping package of highly deformed metavolcanic and metasedimentary rocks. The volcanic rocks are predominantly gabbroic-textured mafic flows and tuffs. The sediments are interpreted to be metamorphosed volcaniclastic greywackes. The iron formations are predominantly

oxide facies and consist of alternating bands of magnetite and chert with local concentrations of silica, iron silicates and sulfides.

Rocks in this area have undergone polyphase folding. A three to five km wide, NW-trending, dextral shear zone is located immediately south of the mineralized iron formation. Intense shearing has imparted a cataclastic texture to many of the rocks. Metamorphic grade varies from upper greenschist facies in the "Discovery" area to amphibolite facies, north and south of "Discovery".

Gold mineralization within the iron formation is associated with intense alteration (development of iron silicates: grunerite, actinolite, chlorite, hornblende), sulfidization (pyrrhotite, arsenopyrite, pyrite) and silicification (quartz flooding and veining). At present, the controls on the mineralization are not fully understood; however, the better gold values are associated with F_2 parasitic z-folds on the south limb of an overturned synform.

A total of 1,118 m of diamond drilling has been completed on the project. Thirteen out of 14 holes encountered visible gold. To date, the best drill intersection is 12.40 g/t gold over a core length of 12.12 m.

THE NERCO CON MINE, YELLOWKNIFE, N.W.T.: MESOTHERMAL GOLD LODES IN RETROGRADE SHEARS ACTIVATED BY LATE-KENORAN UPLIFT

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The Nerco Con Mine (85 J/8) is situated within amphibolitized Yellowknife belt greenstones bordering the Western Granodiorite batholith. The immediate volcanic sequence forms an upright monoclinal succession striking 050° and dipping moderately to steeply south. The metamorphic overprint increases from upper greenschist to mid-amphibolite facies toward the greenstone/granodiorite contact. Metamorphic isograds transect volcanic stratigraphy and subparallel the now strongly faulted margin to the batholith. That part of the greenstone belt above greenschist facies conditions is extensively injected by north-trending gabbro-diorite dykes that underwent moderate clockwise rotation during prograde metamorphic overprinting.

At the latitude of the Nerco Con Mine granitic plugs and dykes and a number of related breccia bodies define an east-west striking intrusive corridor. The intrusive bodies include the Pud Lake stock, the buried Negus plug exposed in the central mine workings, and numerous dykes between the Negus Shaft and the shoreline of Yellowknife Bay. Breccia bodies include granite-matrixed, quartz feldspar porphyry related, gas corrosion and hydrothermal breccia-types. At the mine site the regional hornblende amphibolite isograd projects eastward and merges with a domain of hornblende hornfels related to the intrusive corridor.

The gold mineralization is confined to north-striking, west-dipping shear zones in which the amphibolite facies mineral assemblages are variably retrogressed. The final chlorite retrogression with movement of auriferous shears clearly postdates peak metamorphic conditions. Locally, shears can be observed crosscutting both granite apophyses and the main mass of the Western Granodiorite. Regionally, the shears broadly define a NNE-trending tectonic grain intermediate between the N-trending late dyke suite and the ENE-trending bedding planes. The major Con and Campbell shear zones respectively occur near the regional epidote-out and chlorite-out isograds within this aureole. The Negus-Rycon veins, occurring between the Con and Campbell shear systems, closely follow the margins of late dykes and transect the hornfelsed intrusive corridor.

The gold lodes are interpreted to be metamorphogenic. Proof that high temperature prograde fluids produced amphibolite facies conditions (500°C) promoted greenschist facies retrogression (350°C) within late shears is tenuous. Nevertheless, the general increase in low temperature mineral phases in shears away from the granodiorite and the respective coincidence of the main Con and Campbell shears with regional isograds does support a metamorphic lineage. The zoning of shears from chlorite-calcite on the margin to sericite-ankerite-pyrite in the interior and Fe-chlorite selvages on Au-bearing vein margins indicates a progressive decline in temperatures. With declining temperatures Au-S(As-Sb) complexes are destabilized and precipitate gold with a variety of sulphides and sulphosalts.

Coupling of regional prograde and restricted retrograde metamorphic overprints calls for a dynamic uplift history following the emplacement of the Western Granodiorite. Channelling of contained metamorphic fluid into local domains undergoing rapid uplift may have played a critical role, with fluid overpressuring initiating the updip propagation of fluidized shear zones.

GOLD AND WHERE IT IS FOUND, YELLOWKNIFE MINING DISTRICT, NWT (NTS 85 J/7,8,9 & 16)

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The topic of gold mineralization in the Yellowknife region has been popular since discovery of the precious metal at Burwash Point in 1934. Many papers and books have focused on the metallogeny and genesis of the ore deposits in the Yellowknife mines. This study undertook the examination of smaller and lesser known showings in the district.

Gold showings, identified from a variety of sources including assessment files, government compilation maps and personal communications, were examined. Several unreported showings were discovered which compensated for the few that could not be found. The geological setting of each showing was mapped and the economically interesting minerals were identified. Additionally the mineral sequences, host rock, small scale structural features, wall rock alteration and metamorphic grade were recorded.

Two sampling biases were used. At each showing, a grab sample of the most mineralized rock was collected and assayed for Au, As, Co, Fe, Mo, Ni, Zn, Mn, Pb, and Cu. Where a variety of distinct vein mineral assemblages or a

distinctive alteration of the host rock was apparent, a suite of samples for geochemical analysis and polished sections were gathered. A total of about 220 sites were visited and over 400 samples were collected.

Based on the fieldwork and preliminary analysis of the data several conclusions can be made.

A)Five distinct events affect gold deposition.

1)Syngenetic to early epigenetic deposition of pyrite and pyrrhotite formed stratabound accumulations in sediments such as at the contact between the felsic Banting Group and the metasedimentary Burwash Formation, or filled amygdules and fractures in mafic volcanic rocks of the Kam Group. These deposits are best preserved in relatively undeformed rocks.

2)An arsenic-rich event is represented by smoky to blue/grey quartz arsenopyrite veins. Arsenopyrite occurs as fine grained amorphous masses or euhedral crystals. Wall rock alteration is characterized by arsenopyrite porphyroblasts. The veins and alteration are best developed in highly foliated rocks and most have been extensively deformed.

3)Galena-sphalerite-chalcopyrite-bornite in quartz +/- carbonate veins locally cross-cut the quartz arsenopyrite veins along brittle straight fractures. There is little associated wall rock alteration. Many have been extensively deformed and now are indistinguishable as a distinct assemblage in shear-hosted deposits.

4)White glassy quartz veins with vugs and fractures filled by molybdenite and pyrite have cross cut in some granitoid plutons and adjacent mafic volcanic rocks. These veins commonly follow older shears and may show evidence of post-emplacement deformation.

5)Hematite mineralization is manifested as fracture fills of specularite or by hematized jasper, quartz, carbonate and chalcopyrite in late faults. This mineralization is interpreted as Proterozoic in age.

B)Events 2 - 5 are recognizable in the Western Plutonic Complex and older lithologies, suggesting that mineralization commenced after partial solidification of the Western Granodiorite. Gold showings are in all the major rock types of the Yellowknife region except the conglomerates of the Jackson Lake Formation and the Proterozoic diabase dykes.

C)Generally, the mineralizing processes took advantage of pre-existing path ways including shears, and fractures often coinciding with lithological contacts.

D)Gold deposition or remobilization was associated with all five of the mineralization events, but economically significant concentrations are present in showings most strongly affected by the arsenopyrite and galena-sphalerite events. Of the two, geochemical evidence suggests that the latter was the more important event.

MAGNETITE DEPOSITS OF FELSIC MAGMATIC AND CLASTIC ORIGIN IN SOUTHERN GREAT BEAR MAGMATIC ZONE, NORTHWEST TERRITORIES

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Two types of magnetite deposits occur in southern Great Bear magmatic zone: i) breccia-fillings and veins in the felsic volcano-plutonic complex, and ii) stratiform magnetite-hematite concentrations in metasiltstones of the older Snare Group. Examples of the first type are the Sue-Dianne and Mar deposits near Mazenod Lake (85 N/15), and of the second type are the Hump Lake North and nearby Ron deposits (85 N/10).

The breccia-fillings and veins contain notable amounts of Cu, U and Au. They belong to a varied group which includes large tabular magnetite-apatite-actinolite deposits of the Kiruna district in Sweden, and the hematite-magnetite breccias, containing Cu, U and rare earths, of the giant Olympic Dam deposit in South Australia. These are all genetically related to continental felsic magmatic activity. Hence the Great Bear magmatic zone has a potential for large polymetallic deposits.

The stratiform deposits are in quartzo-feldspathic siltstones, which may be volcaniclastic in part. The siltstones were tightly folded and metamorphosed to amphibolite facies, during late Aphebian events. These events were followed by the Great Bear magmatic activity circa 1850 Ma.

GEOLOGY OF THE HOPE BAY AND ELU INLET METAVOLCANIC BELTS, BATHURST BLOCK, NORTHEASTERN SLAVE PROVINCE, N.W.T.

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The Archean Hope Bay (NTS 76 O/9, 10, 15 & 16; 77 A/3 & 6) and Elu Inlet (77 A/2, 7 & 10) metavolcanic belts are in the Bathurst Block of the northeastern Slave Province. The Hope Bay belt was mapped during 1988-89 (EGS-1990-15). During 1990 the northern portion of the Elu Inlet belt (77 A/7 & 10) was mapped at a scale of 1:50,000 and the southern portion (77 A/2) was mapped by helicopter reconnaissance (EGS-1990-20).

Hope Bay belt

The Hope Bay belt is dominated by mafic volcanic and intrusive rocks. Other lithologies include felsic volcanic, volcaniclastic and intrusive rocks, metasedimentary rocks, and minor iron formation and ultramafic sills. The belt is bordered to the east and west by granite to granodiorite, and to the southwest by a heterogeneous gneiss terrane derived partially from supracrustal rocks. The metamorphic grade of the belt increases from greenschist to amphibolite-facies towards the contact with the granitoid rocks. A conglomerate composed of clasts of granite and supracrustal rocks from the Hope Bay belt, crops out in Hope Bay at the northern end of the belt. This conglomerate unconformably overlies vertically dipping mafic rocks and is the youngest recognized supracrustal rock of the belt. Aphebian sedimentary rocks

overlie the belt at its northern end. Mackenzie and Franklin diabases cut the rocks of the Hope Bay area.

The Hope Bay belt is structurally complex bearing the overprint of several subparallel, north-trending fabrics. These fabrics locally include two foliations and structures related to shearing and late faulting. The least-deformed rocks of the northern Hope Bay belt indicate the belt was isoclinally folded into a series of north-trending anticlines and synclines, and cut later by north-trending shear zones and faults.

Elu Inlet belt

The Elu Inlet belt is composed of similar lithologies to the Hope Bay belt, consisting of mafic volcanic and intrusive rocks with subordinate felsic volcanic rocks, metasedimentary rocks and ultramafic sills. The belt is overlain by Helikian sedimentary rocks, and disappears under sedimentary cover on the Kent Peninsula to the north. The southern half of the belt is metamorphosed to amphibolite-facies and many primary features of the rocks are destroyed.

Structural patterns of the northern Elu Inlet belt are similar to the Hope Bay belt with north-trending isoclinal folds overprinted by later shearing and faulting. Late northeast-trending dextral faults have offset the contacts of the Elu Inlet belt.

Economic Potential

The Hope Bay and Elu Inlet belts have the following types of mineralization; i) lode gold, ii) volcanogenic massive sulphides, iii) vein silver, and iv) pegmatite related molybdenite. To date the most interesting gold showings are in the Hope Bay belt. Gold is in quartz-carbonate veins that cut: i) carbonatized shear zones along the medial axis of the belt; and ii) the eastern amphibolitic margin of the belt. Massive sulphide showings are preferentially developed along mafic/felsic contacts. Most sulphide showings are interpreted as distal volcanogenic massive sulphide deposits. High-grade native silver is associated with east-trending carbonate-filled fracture zones in the northern Hope Bay belt. These deposits have produced approximately 10,000 oz of silver.

Many north-trending gossans and gossan zones were noted in the Elu Inlet belt during the 1990 mapping season. The largest are formed above late, north-trending, pyrite-rich faults. Samples assayed from these faults have not detected gold. Smaller gossans are developed along mafic/felsic contacts in the central portion of the Elu Inlet belt. One zone of these gossans has a strike length of 7 km. Grab assay samples indicate that this zone is in places weakly mineralized (0.2% Cu, 0.4% Pb, 0.6% Zn). Disseminated molybdenite is in pegmatite and in quartz veins along the western contact of the Elu Inlet belt. Grab samples had a maximum 0.14% Mo. East-trending, carbonate infilled structures were noted in the western contact zone of the Elu Inlet belt. These structures did not contain native silver. Ultramafic sills are present in both belts although only the more highly metamorphosed sills of the southern Elu Inlet belt are suitable for carvingstone.

NORTHWEST TERRITORIES TRANSPORTATION STRATEGY

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Released in October 1990, the Northwest Territories Transportation Strategy presents the Government of the Northwest Territories views on transportation development needs into the twenty first century.

Extensive consultation with the public, industry and various government agencies has identified a variety of problems/opportunities relating to transportation in the North. Our existing highways, airports and marine facilities are substandard and inadequate. Our highway system is underdeveloped. The high costs and regional inequities in transportation restrict social, economic and political development.

The goal of the Transportation Strategy is to **ensure the safe, accessible and reliable movement of people and goods to meet the economic, social and political needs and aspirations of the people of the Northwest Territories and Canada.**

The principles include, ensuring **public safety**, protection of **renewable resources**, **integration** of transportation planning, maximizing **opportunities for northerners**, reducing regional **disparities** and obtaining **value for money**. The Strategy also strives to **balance** social, economical and political development priorities.

Four strategic objectives have been identified:

1. **Improving What We Have** - Upgrading existing air, road and marine transportation facilities and systems.

2. **Pushing Back the Economic Frontiers** - Major new road construction to open the northern hinterlands for responsible development.

3. **Filling the Gaps - Transportation Subsidies** - A comprehensive approach to reducing regional inequities in the cost of transportation services.

4. **Excellence in Transportation Programs** - Ensuring effective and efficient delivery of transportation programs and services.

Of these, the second and most ambitious objective is of most interest to the mining sector.

The scope of this Strategy exceeds the mandate of the Government of the Northwest Territories. The costs of implementing its objectives far exceed the resources available to this government. However, the Strategy offers enormous potential benefits to Canada as well as the North.

The Government of the Northwest Territories therefore intends to seek a renewed partnership with the federal government and the provinces to find the necessary resources.

TECTONIC EVOLUTION OF THE SLAVE PROVINCE: CAN MODERN ANALOGUES PROVIDE NEW INSIGHTS?

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The number of tectonic models for Archean granite-greenstone terrains is still only slightly smaller than the number of geologists working on Archean rocks. Non-uniformitarian models, providing few limits to the imagination, are based on the notion that ophiolites and eclogites, indicative of ocean-floor spreading and subduction during the Phanerozoic, are absent from the Archean record, that the tectonic style of granite-greenstone terrains is unique to the Archean, and that the presence of komatiitic rocks is evidence for higher degrees of mantle melting and consequently higher geothermal gradients during the Archean. On the other hand, uniformitarian models, especially those attempting to infer Archean tectonic processes from igneous rock compositions, are weakened by our imperfect knowledge of the relationships between magmatism and tectonic environments in the Phanerozoic and recent igneous record. Improvement of Archean models thus depends equally on a continued reassessment of what is truly unique to the Archean and on an improved understanding of Phanerozoic and recent tectonic processes. To illustrate this point, the tectonic consequences of the recently proposed analogy between certain Slave Province greenstone belts and Phanerozoic ophiolites are explored, and Slave Province structural patterns and sequences are compared with those in an active orogenic setting (Makran region of Baluchistan), where plate interactions are relatively well understood.

Regardless of the fact that lithologic assemblages of Archean mafic volcanic belts (greenstone belts) do not correspond to those of Phanerozoic ophiolites (as defined by Anonymous, 1972, Geotimes, v. 17, pp. 24-25), the large accumulations, though different proportions, of massive and pillowed mafic flows and related gabbros in both assemblages represent the only plausible remnants of "oceanic crust" in the geological record of their respective times. As true MORBs are rare in both assemblages, neither greenstone belts nor most ophiolites are directly comparable to present-day ocean floor. The value of the greenstone belt - ophiolite analogy lies in the fact that tectonic patterns of greenstone belts are very similar to that of metamorphosed and dismembered ophiolites in Phanerozoic orogenic belts. Models assuming that all greenstone belts are autochthonous should thus become implausible when most ophiolites are known to represent allochthonous slices that can be used successfully to delineate tectonic terrane boundaries. Accepting this reasoning, similarities in tectonic patterns with the Makran region help to elucidate relationships between greenstone belts, basement blocks, turbidite basins, calc-alkaline magmatism, and the deposition of late, polymictic conglomerates in the Slave Province. The comparison also provides new insights for the understanding of time relationships and causes of pre-granite structures in the turbidites and mafic volcanics. An important conclusion for the Slave Province is the suggestion that early mafic volcanic belts are indeed allochthonous, their present distribution having been controlled by lateral interactions between different basement blocks (terranes) and later intrusive activity, whereas the distribution of calc-alkaline magmatism is unrelated to near-surface structures in the assembled Slave nucleus but was controlled by widespread shallow subduction, probably affecting the entire province.

GEOLOGY OF THE WHITEHILLS-TEHEK BELT: IRON-FORMATION-HOSTED GOLD MINERALIZATION IN A REMNANT OF AN ARCHEAN "GREENSTONE" BELT IN THE NORTHERN CHURCHILL PROVINCE*

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Mapping in the Whitehills-Tehek area (56 D & E; 66 A & H), about 50 km north of Baker Lake, placed iron formation-hosted gold mineralization into a regional tectonic setting. In this part of the Churchill Structural Province (Rae Province) the deformation is almost entirely late Archean in age. Complex structural development of the area includes early stratal disruption (D_1), possibly by low-angle faulting, that obscures the original stratigraphy. Gold mineralization occurs in iron sulphide-magnetite-quartz bearing iron formation in contact with chemically altered and foliated ultramafic rocks. Diamond drilling by an exploration company showed that highest gold values occur in nearly vertical beds of iron formation which form the hinge of a recumbent fold. Regional mapping aided by aeromagnetic vertical gradient maps showed that the mineralized structure is a parasitic fold on the overturned limb of a regional north-vergent F_2 antiform. Undeformed late Archean batholiths bound the belt, and the youngest structure is an upright, north-trending F_3 synform believed to be due to granite emplacement.

* Project partially funded by Canada-NWT Mineral Development Agreement 1986-1991.

STYLES OF GOLD MINERALIZATION IN THE ARCHEAN HOOD RIVER BELT, DISTRICT OF MACKENZIE, N.W.T.

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Gold prospects near Turner Lake and Pistol Lake to the north and south of the belt have been explored by mining companies. Our mapping in the area between the prospects (76 N & K) places them in a regional context. The supracrustal rocks in the area are characterized by a more than 15 km thick homoclinal succession, generally east-facing, dominated by distal turbidites and siltstones, with lesser amounts of volcaniclastic and intrusive rocks of intermediate to mafic composition, iron formation and pebble to cobble conglomerate. The conglomerate and volcanic rocks pinch out along strike and the units of iron formation decrease in importance away from the conglomerate, suggesting the former presence of an active volcanic island within the filling basin. This is also supported by the presence of soft sediment folding and a local unconformity at the base of the first conglomerate, consistent with sudden uplift due to volcanism.

Uniform metamorphic grade (andalusite-cordierite) along and across strike and pervasive cleavage with clockwise relationship to bedding characterize the belt. Random inclusions within porphyroblasts indicate that cleavage forma-

tion postdates peak of metamorphism. Most of the granitic rocks intruded passively after deformation.

Lithological, metamorphic and structural elements suggest that an extensional basin containing a volcanic island was tilted to a near vertical position, possibly during a collisional event. Porphyroblasts then grew under nearly static conditions and oblique stresses later imposed the regional cleavage overprinting the porphyroblasts.

The Turner Lake prospect is proximal to the main volcanic centre north of our mapping area; gold was observed in quartz veins cutting altered intermediate to mafic volcanic and epiclastic rocks. The host rocks are heavily sericitized and the protolith unclear.

In the area of Pistol Lake, 15 km to the south, gold is reported to occur in sulphide-bearing zones within two distinct units of iron formation, one oxide-rich, one silicate-rich.

While the gold observed at Turner Lake is no doubt secondary, it might well be remobilized-synvolcanic in origin. In the Pistol Lake prospect, available information suggests that at least some of the gold is not vein related and may be syngenetic or early epigenetic.

NEW GEOLOGICAL DEVELOPMENTS IN THE INTERNAL ZONE OF WOPMAY OROGEN, DISTRICT OF MACKENZIE (86 F)

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The internal zone of Wopmay orogen comprises a large klippe of 2.0-2.55 Ga gneissic rocks, termed Bent gneiss, and 1.90 Ga volcanic and sedimentary cover of the Grant-Akaitcho groups. Rocks of the Grant-Akaitcho groups probably formed near the leading edge of Hottah terrane just prior to the initiation of the Calderian orogeny. The gneissic basement and its cover were tectonically interleaved along west-vergent thrusts during the earliest stages of the Calderian orogeny. They were subsequently emplaced upon the Slave craton. Lineations in the klippe and the autochthon indicate that the emplacement of the klippe was oblique dextral. Final Calderian compression resulted in the formation of large northerly-trending folds.

PROTEROZOIC GEOLOGY OF THE NORTHWESTERN CANADIAN SHIELD

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The area includes rocks in the northern half of the 1.9 Ga Wopmay orogen and the 1.7-0.8 Ga Coppermine homocline. Rocks of the Coronation Supergroup, located in eastern Wopmay orogen, unconformably overlie rocks of the rifted western margin of the Archean Slave craton and comprise a shelf-rise and overlying foredeep succession that was tectonically shortened, transported eastward along a basal decollement, and intruded by 1.9-1.88 Ga mafic to sileous magmas during accretion of a 2.4-1.9 Ga arc-bearing microcontinent. Eastward subduction following collision led to continental arc magmatism during the period 1.8801.86 Ga. Shut-down of arc magmatism was followed by oblique folding of the arc rocks; intrusion of 1.86-1.84 Ga granitic plutons; and finally, east-west compression resulting in an orogen-wide swarm of conjugate transcurrent faults.

Rocks of the Coppermine homocline unconformably overlie Archean and Proterozoic rocks of Wopmay orogen and comprise four distinct packages of supracrustal rocks separated by unconformities: the Hornby Bay Group, the Dismal Lakes Group, the Coppermine River Group, and the Rae Group, in ascending order. Both the Hornby Bay and Dismal Lakes groups are basically siliciclastic to carbonate successions. Magmatism in the Hornby Bay Group indicates deposition at about 1.66 Ga. Rocks of the 1.27 Ga Coppermine River Group consist of a thick sequence of flood basalts overlain by fluvial sediments and basaltic lava flows. Eastward to southward vergent thrust faults in the group may be related to a Proterozoic thin-skinned thrust-fold belt located in the subsurface to the west between Great Bear Lake and the Beaufort Sea. The Rae Group, comprising sandstones, shales, and carbonates, caps the sequence; unconformably overlies the thrust faults; and is profusely intruded by 0.75 Ga gabbroic sheets known as the Coronation Sills.

GEOLOGICAL MAPPING IN THE KATHAWACHAGA LAKE AREA (76 L), NORTHERN SLAVE STRUCTURAL PROVINCE

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During 1990, geological mapping in the Kathawachaga Lake area was completed. This work, carried out at a scale of 1:30,000, is being compiled together with the results of three previous field seasons onto a 1:125,000 scale map. Areas investigated in 1990 included 76 L/1, 7 and 8 and parts of 76 L/2, 5 and 6.

Southeastern area (76 L/1 and part of 2)

Metasediments containing layers of amphibolitic iron formation may be equivalent to the Contwoyto Formation, which has been defined in the Point Lake-Contwoyto Lake area. The metamorphic grade of these rocks ranges from medium to high grade. Cordierite-andalusite schists form a north to northeast trending metamorphic zone, bounded to the east and west by the sillimanite zone followed by a zone of migmatitic (high grade) metasediments. Analysis of mesoscopic structural elements indicates the following sequence of fabric and fold formation:

a) The earliest fabric recognized is a mica foliation (S_1) that is preserved within cordierite or andalusite porphyroblasts or in the microlithons between S_2 surfaces.

b) The most prevalent fabric (S_2) is defined by the alignment of micas and biotite segregations in the matrix to cordierite or andalusite porphyroblasts. S_2 clearly wraps around these porphyroblasts although cordierite, andalusite and sillimanite knots (at appropriate metamorphic grades) are locally aligned in the S_2 plane. S_2 has a variable orientation. In the high grade metasediments S_2 is an axial plane foliation to tight to isoclinal folds of granitoid (leucosome?) veins.

c) S_2 is deformed into tight to open folds with northeast and northwest trending axial traces.

Central parts of 76 L/7 and 8)

High grade metasediments form a migmatite complex that is bounded to the north by sillimanite-zone metasediments, but also locally encloses these lower grade rocks. Sillimanite-bearing metasediments within the complex occupy the core of a north to northwest trending synform. These rocks preserve a north to northwest trending foliation (S_1?) that is defined by the alignment of micas. Sillimanite pods are aligned along S_1 surfaces. S_1 is deformed by east-west trending F_2 folds with upright to north dipping axial planes parallel to which an axial plane foliation (S_2) is defined. The main tectonic fabric within the migmatitic metasediments is a westerly trending foliation (S_2) defined by the orientation of biotite - sillimanite aggregates (melanosome). Superposition of F_2 and F_1 resulted in type 3 fold interference patterns. Subsequent deformation resulted in the development of both northeast and northwest trending folds. The nature of the transition from medium grade sillimanite-bearing metasediments to migmatitic sediments was briefly examined. Textural evidence supports in situ generation of some of the granitoid leucosome material; however, a large part of the leucosome may have been derived and injected from an external source. The preservation of garnet-amphibole +/- sulfide-bearing pods within the migmatite terrane suggests these may represent high grade Contwoyto Formation.

Three Hour lake area (76 L/5)

Mafic and felsic volcanic and subordinate pelitic sedimentary rocks underlie approximately 20 square kilometres and constitute the remnants of a supracrustal succession that has undergone amphibolite-facies metamorphism and extensive granitic intrusion. The main tectonic fabric is a westerly to southwesterly trending foliation (S_2?). Siliceous rocks are locally enriched in pyrite, pyrrhotite and rarely chalcopyrite.

The orthogonal relationships between successive deformational events may be utilized to interpret the present distribution of lithologies across the Kathawachaga Lake map area in terms of intersecting large scale structures.

GEOLOGY OF THE TORP LAKE METASEDIMENTARY BELT AND REPORT ON NEW GOLD/BASE METAL SHOWINGS (76 N/3,5,6 & 11)

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The Torp Lake metasedimentary belt is 580 km north-northeast of Yellowknife and centered 25 km west of Arctic Sound in the northern Slave Province. A three year program to map the Torp Lake belt (TLB) was initiated in 1988 and completed during 1990. A discussion of the findings of the first two field seasons has been presented previously (Johnstone, 1988, 1989). This abstract summarizes the results of 1990 mapping in the northern half on the TLB and along the belt's southeast margin. Preliminary results of limited mapping in the northern tip of the Hood River supracrustal belt are also presented.

Torp Lake Belt

The Torp Lake belt is bounded to the east by the Bathurst Fault and to the west and southwest by biotite-hornblende granite/granodiorite batholiths. Proterozoic rocks underlie the area east of the fault (Figure J-1). Two Proterozoic rock formations are present along the Bathurst Fault: the Helikian Parry Bay Formation (terminology after Fraser, 1964) adjacent to the northern tip of the TLB; and the Aphebian Burnside River Formation (terminology after Campbell and Cecile, 1975) of the Goulburn Group, which outcrops further south. The nature of the unconformity between the two formations is unknown. Porphyritic melanogranite is present as large xenoliths within the biotite-hornblende granite/granodiorite bordering the northern end of the belt. A younger muscovite-biotite granite forms small stocks throughout the region.

Metasedimentary rocks are mainly medial to distal turbidites: wackes, siltstones and mudstones. Rare chert beds and sulphide-facies iron formation are also present. The iron formations, confined to an area at the northwestern edge of the TLB, are thin (m) and traceable for no more than 300 m.

Metamorphic grade increases southward in the TLB from greenschist to amphibolite facies as evidenced by a succession of west-trending metamorphic mineral zones (biotite, cordierite+andalusite and sillimanite+muscovite). A north-trending cordierite+andalusite zone is also present along the northwestern edge of the belt. Although largely obscured by a muscovite-biotite granite stock, the cordierite-andalusite isograd defining this zone trends approximately parallel to bedding. The metasediments between the granite stock and the batholith to its west contains the highest concentration of sulphide-enriched garnet-amphibolite alteration zones in the belt. Quartz and quartz-carbonate veins associated with these alteration zones have a northerly trend.

Most of the bedding strikes north to northwest and dips moderately to steeply on the limbs of tight to isoclinal folds (F_1) with sub-vertical and east-dipping axial planes. The folds have a wavelength of 2-12 km and generally display a shallow to moderate plunge to the south. In places, a transition to a northerly plunge can be recognized along some hingelines.

In pelitic beds, S_2 is a northwest-trending foliation preserved as inclusion trails in cordierite porphyroblasts. S_3 is expressed as a slaty cleavage in greenschist rocks and a schistosity or crenulation cleavage in higher grade rocks. S_3 trends northeast and is overprinted by a subhorizontal crenulation cleavage (S_4) in greenschist and lower-amphibolite-facies pelites. This cleavage is in turn overprinted in greenschist-facies pelites by a steeply-dipping, northwest-striking crenulation cleavage (S_5). Proterozoic strata and diabase dykes and sills (excluding Mackenzie diabase dykes) are gently folded about shallow-plunging, north- to northwest-trending axes. North to northwest striking faults related to the Bathurst Fault are the most significant Proterozoic structures recognized in the region. These faults splay out from the Bathurst Fault along the southeastern edge and across the northern half of the TLB. Apparent sinistral displacements of over 1 km are recorded along some of these faults. However, significant vertical displacements are indicated by a fault-bounded block of Perry Bay Formation rocks

isolated within the northern half of the TLB. The block consists of sub-horizontal beds of interclast-bearing dolomite, dolarenite, and calcareous, concretionary mudstones and siltstones intruded by a diabase sill.

Northern Tip of the Hood River Belt

Turbidites in the northern tip of the Hood River belt (HRB) are similar to those in the central TLB. However, the sequence also includes a 150-300 m thick conglomerate unit referred to as the James Falls Conglomerate (Roscoe *et al.*, 1988). This conglomerate includes a variety of metasedimentary clasts but consists primarily of clasts of quartz diorite or dacite. The unit thickens northward from the James River.

All strata young eastward and strike north to north-northwest. The exception is where strata are locally rotated in drag folds adjacent to sinistral faults which splay from the Bathurst Fault.

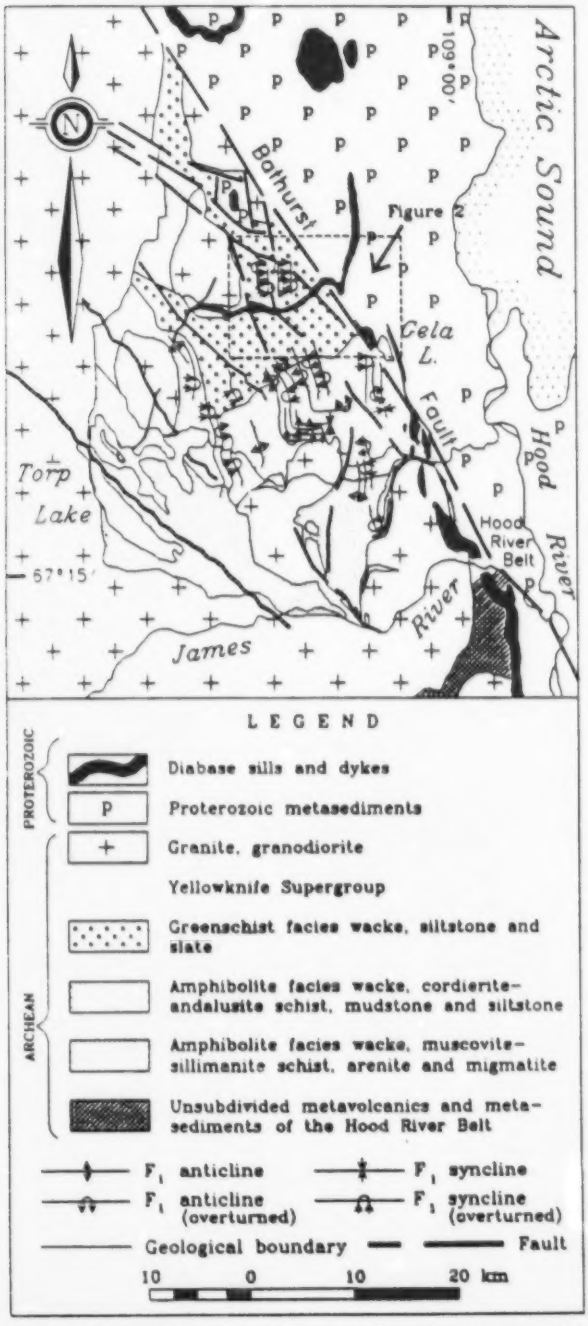

Figure J-1: General geology of the Torp Lake metasedimentary belt.

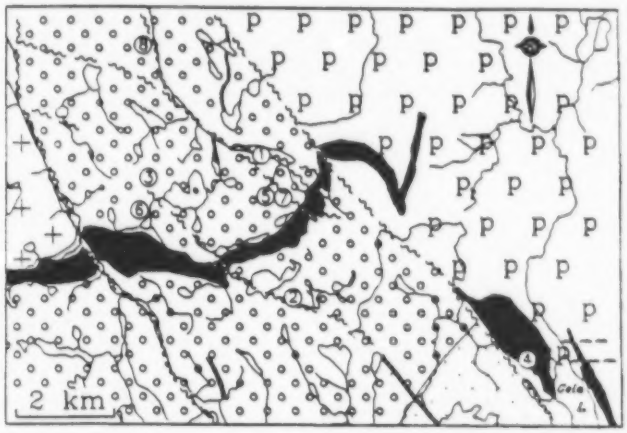

Figure J-2: Sample sites.

TABLE J-1: Significant Assay Data from the 1990 Field Season

Sample No.	Au g/t	Ag ppm	As ppm	Cu ppm	Fe %	Pb ppm	Zn ppm
1	143.76	36.0	22500	151	2.4	10400	3200
1*	142.00	62.0	23000	n/a	3.0	n/a	3740
2	6.58	20.0	6190	93	1.96	10000	127
2*	9.46	16.0	6400	n/a	2.19	n/a	164
3	5.00	8.6	497	341	2.17	46	45
3*	10.30	<5	550	n/a	2.37	n/a	74
4	4.50	22.0	3650	11200	10.1	54	370
4*	7.03	42.0	3500	n/a	11.1	n/a	410
5	3.09	0.5	26800	41	2.63	56	3100
5*	1.90	<5	29000	n/a	3.37	n/a	3600
6	2.12	0.4	6390	43	2.26	46	130
6*	0.61	<5	6000	n/a	2.79	n/a	154
7	0.63	0.7	965	68	8.75	25	112
8	0.71	0.6	38700	31	5.4	9	45

* duplicate pulp sample.

A westward increase in metamorphic grade in the belt is suggested by a transition from cordierite+andulusite facies to sillimanite+muscovite facies near the western edge of the belt. This may represent the structural juxtaposition of two metamorphic mineral zones.

Cordierite porphyroblast-matrix relationships differ between the HRB and TLB pelites. S_2 and the incipient development of a northeast-trending crenulation cleavage (S_3) are preserved in the Torp Lake belt porphyroblasts whereas Hood River belt porphyroblasts preserve only the S_3 cleavage. The peak of thermal metamorphism was reached slightly earlier than S_3 development in the TLB rocks. Porphyroblast growth in both groups of rocks terminated prior to the completion of S_3 development.

Economic Potential

The Bathurst Fault and its related splays are characterized by zones of hematite alteration and 1 m to 15 m wide, Fe-carbonate flooded fault breccia zones. The carbonate matrix commonly hosts disseminated chalcopyrite and may also have vuggy, quartz-calcite veins bordered by massive chalcopyrite. Chalcopyrite, galena, pyrite, arsenopyrite and sphalerite are the most prominent sulphides in the quartz-carbonate veins. Sampling of these sulphide-enriched quartz-carbonate veins has confirmed anomalous concentrations of gold (up to 143 g/t). Assays from the sampling of five quartz-carbonate veins in Proterozoic gabbro and Goulburn Group rocks along the Bathurst Fault and along three sub-parallel faults west of the Bathurst Fault are reported in Table J-1 (samples 1-5) (See also Figure J-2).

Pyrrhotite, pyrite and arsenopyrite are concentrated within narrow (m), rusty weathering, amphibolite lenses and the bedding-parallel quartz and quartz-carbonate veins which core them. These are found throughout the Torp Lake belt and are generally associated with north-trending shear zones. Assays of samples from such lenses have generally not indicated significant gold concentrations. However, three assays, ranging from 0.61 to 2.12 g/t Au, from samples taken from arsenopyrite-enriched quartz and quartz-carbonate veins (samples 6-8, Table J-1) indicates that these veins may have some exploration potential. None of the iron formations sampled yielded anomalous gold concentration.

Nineteen new claims were staked by the end of the 1990 field season. The selection of most of these claim areas was based on the results of the mapping conducted during 1988 and 1989 which had indicated several areas of gold potential.

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EXPLORATION OF THE WALSH LAKE GOLD PROPERTY YELLOWKNIFE AREA, (85 J/9)

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NEBEX Resources Ltd. (A.S.E.) holds title to 20 claims totalling approximately 6000 acres located in the Walsh-Banting Lakes area about 10 miles north of Yellowknife.

Surface prospecting in the area in the 1930's and early 1940's located at least a dozen gold and polymetallic base metal showings, four of which were subsequently tested by shallow X-ray drill holes. Although gold values were confirmed, values were judged to be too erratic and interest in the area declined after 1950.

Kelmet Resources Ltd. assembled its land package in 1985 and, between 1986 and 1988, the company covered the north half of the property with programs of prospecting, detailed geological mapping, soil/rock geochemical sampling, and geophysical surveys. In 1988 the MOS claims were optioned from Rio Algom and the LES claims were added. In 1989 the company conducted a 3,100-foot drill program to test the Sam Otto zone. Kelmet optioned the property to NEBEX Resources Ltd. in 1990.

The claims cover a fault-modified north-trending east-facing homoclinal succession of Archean volcanics and sediments comprising (in ascending order): intermediate to felsic crystal, ash, and cherty, siliceous tuffs; greywacke/mudstone with intercalated sulphide iron formation; a second cycle of felsic pyroclastics overlain in turn by turbidite-type sediments. Lensoid sills of gabbro occur at several locations in the lower felsic sequence and are considered to be subvolcanic intrusives contemporaneous with formation of the felsic pile. The upper felsic sequence appears to be discontinuous in the northern half of the property. The upper contact between these felsics and the overlying sediments is marked by a thin (less than 10 feet) discontinuous sulphide iron formation.

Within the area explored to date, gold mineralization has been found in the following environments:

1.in conformable sericite-carbonate-quartz schist zones in the upper stratigraphic intervals of the lower felsic sequence,

2.in lensoid quartz masses and irregular veins in sulphide iron formation within the lower sedimentary sequence,

3.in association with polymetallic base metal mineralization in silicified tuffs and fragmentals of the upper felsic sequence,

4.in sulphide-silicate iron formation along the transition zone between the upper felsic sequence and overlying sediments, and

5.in epigenetic quartz veins and stockworks in the same transition zone.

Gold showings and occurrences are distributed along conformable "trends" or "zones" at more or less well-defined stratigraphic intervals. For the most part, showings are stratiform if not originally stratabound.

Exploration has been focused on the Sam Otto - Samax Island "trend" within the upper section of the lower felsic sequence. Prospecting, outcrop and soil sampling, and geological mapping have shown that gold mineralization and/or elevated gold values are contiguous along a strike length of at least 2.8 miles (4.5 km).

The 1989 drill program on the Sam Otto zone showed that, within the area tested, the zone comprises at least 15 discrete stratiform, gold-bearing sericite-carbonate schist zones varying in width from 1.0 to 30.0 feet. Section-to-section correla-

tion of individual zones demonstrates with reasonable certainty that mineralization is stratabound as well as stratiform within water-sorted fall sequences of felsic ash, crystal tuffs, and possibly, exhalative sediments. Strike direction is consistently north-south with dips generally in the order of 85 - 88 E.

The gold-bearing felsic sequence is intercalated in part with irregular gabbro intrusives and stratiform fine-grained extrusive derivatives and/or hybrids. These intermediate to mafic rocks appear to pre-date mineralization.

Mineralization consists of fine to very fine disseminated pyrite, arsenopyrite, pyrrhotite, and minor chalcopyrite in a gangue of olive-green to tan and buff sericite-carbonate schist with variable amounts of biotite/chlorite, vein quartz, 'cherty' quartz, and late quartz-calcite stockworks in fractures. In general, sulphide content never exceeds more than 10%. Fine tourmaline is a common accessory in most zones, and a few flakes of molybdenite were seen in one short interval.

Adjacent to schist zones, felsic and mafic volcanics are generally carbonated and silicified. Whether carbonate and silica represent a syngenetic exhalative component or superimposed hydrothermal alteration is conjectural. However, whole rock analyses of schist and adjacent host indicate that K-Mg enrichment and Na-Ca depletion has taken place. Minor amounts of accessory pyrite and pyrrhotite occur in some adjacent ash tuff sequences.

Gold values obtained from split drill core samples of sulphide-bearing sericite schist ranged from 0.02 to 0.28 oz/ton. The best gold values were obtained from Hole W89-1 which intersected 0.26 oz/ton over 7.0 feet within an alteration zone averaging 0.133 oz/ton over a true width of 24.0 feet. This intersection is some 220 feet vertically below a trench from which previous sampling yielded values in the 1.0 to 2.0 gram range (0.04 oz/ton). The weighted average of all samples reporting over 0.01 oz/ton is 0.07 oz/ton.

Polished and thin section studies indicate that:

1.gold is associated with pyrite and/or pyrrhotite,

2.the gold-bearing interval may be an altered exhalative sediment within the host sequence of ash and crystal tuffs, and

3.the "gabbros" are of andesitic composition and are probably subvolcanic intrusives/extrusives.

Detailed geological mapping, prospecting, and sampling conducted this year found new gold showings in linear schist zones further north along the trend, extending the strike length of the Sam Otto "zone" to at least 3000 feet.

Positive results obtained to date suggest that the geological setting and style of mineralization are analogous in many ways to that of the Hemlo or Bousquet deposits, and a similar economic potential is indicated for gold mineralization in the Walsh Lake property.

SURFICIAL GEOLOGY OF THE SOUTHERN HALF OF THE 76 L MAP SHEET (KATHAWACHAGA LAKE)

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The surficial geology for 76 L/5 to L/8 was compiled on the basis of air photo interpretation and local ground truthing by bedrock mapping crews under the direction of V. Jackson during the summer of 1990.

The entire 76 L map sheet was glaciated during the Wisconsin glaciation, and all glacial features are associated with this last glacial episode. Two distinct events within this glaciation are recorded in the study area. Evidence for the glacial advance includes drumlinoids, fluted bedrock, striae and grooves. Drumlinoids are associated with extensive till blankets found at lower elevations in 76 L/2, L/3 and L/6 where they are commonly oriented north-south and north northwest-south southeast. Striae have a similar orientation and indicate flow to the north and northwest in these areas, by ice originating to the south of the map sheet. Striae and a spectacular drumlin field in 76 L/1, L/2, L/7 and L/8 suggest that a second lobe of ice situated further east may have crossed southern Bathurst Inlet and flowed northwest, west and southwest. This change in flow direction may be the result of a discontinuity in the flow pattern resulting from two different ice lobes, as first described by Blake (1963). This difference in flow direction is most visible in 76 L/1 where a large glaciofluvial complex separates two sets of ice flow indicators. To the west of this interlobate outwash complex, ice advanced to the north and northwest, whereas to the east of the complex, ice spread-out from the southwest to the northwest. This complex may be the northern extension of a large end moraine further south (Blake, 1963).

Short periods of still-stands in the ice front during retreat are defined by two small lobate morainic ridges in 76 L/6. Hummocky dead-ice topography is also relatively common and reflects the widespread stagnation of ice during deglaciation. Isolated deposits of silty clay, locally stratified, indicate the existence of short-lived proglacial lakes of limited extent and duration in 76 L/7 and L/8. Numerous eskers and kame deposits, some attaining over 35 km in length, were also deposited during this period. The general trend for these features is to the north and northwest.

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TECTONOMAGMATIC EVOLUTION OF THE CENTRAL SLAVE PROVINCE

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Regional mapping and U/Pb zircon geochronology in the Contwoyto Lake area (76 E & F) of the central Slave Province have, together with geochemical studies (Davies and Hegner, 1990; Davis *et al.*, 1990) yielded data important to the interpretation of its tectonic evolution. This part of the Slave Province comprises an early tectonostratigraphic assemblage of arc-type volcanic, turbiditic and intrusive rocks which experienced significant regional shortening and metamorphism before and during intrusion of calc-alkaline plutons.

The igneous component of the early assemblage includes mafic, intermediate, and felsic metavolcanic and metavolcaniclastic rocks (for which one felsic unit has yielded an age of ca. 2667 Ma) as well as ca. 2660-2650 Ma intrusions of tonalite to monzogranite. The metavolcanic rocks are geochemically similar to rocks in modern calc-alkaline volcanic arcs. A thick sequence of rhythmically thin-laminated to thickly bedded turbidites blanket the volcanic rocks. Their contact with the main volcanic belt is not exposed and could be stratigraphic or tectonic. Locally, volcanogenic sediments and minor flows are interbedded with the metaturbidites indicating that some volcanism continued during sedimentation. No evidence has been found for deformation or metamorphism directly related to the ca. 2667-2650 Ma magmatism.

At some time prior to 2608 Ma the early tectonostratigraphic assemblage experienced regional shortening and thickening (D_1) accommodated by isoclinal folding, contractional faulting and cleavage formation under moderate-T metamorphism (P unknown). Because of superposed deformation, the vergence of D_1 is not known. Around 2608 Ma, D_1 structures were superposed by further isoclinal folding, contractional faulting and cleavage formation (D_2) under high-T/low-P metamorphic conditions.

At ca. 2608 Ma, synchronously with D_2 and the thermal peak of high-T/low-P metamorphism, magmatism recommenced with the intrusion of calc-alkaline, hornblende +/- biotite diorite to tonalite plutons that are geochemically similar to those in modern continental-margin or post-accretionary magmatic zones. Further shortening by open folding and domainal cleavage development occurred pre- to post-2585-2580 Ma, at which time the area was intruded by large volumes of peraluminous biotite +/- muscovite granodiorite to granite. The geochemical signatures of these rocks, together with the absence of contemporaneous mafic magmatism suggest a largely crustal derivation. The emplacement of these bodies coincided with regional retrograde metamorphism but locally imposed contact aureoles. Although presently-available geochronological data imply a 25 my gap between calc-alkaline and peraluminous magmatism in the central Slave Province, textural evidence from several plutons as well as data from throughout the province suggest that they are regionally sequential with minor overlap.

These data can be interpreted in a plate tectonic context. The early tectonostratigraphic assemblage is interpreted to preserve remnants of island arc(s) and blanketing turbidites that were shortened, thickened, and transported during D_1; crustal thickening probably contributed to a developing thermal anomaly. The polarity of orogenesis has not been established, but the occurrence of a regionally extensive 2.9 Ga terrain in the western Slave Province that is structural basement to the supracrustal rocks, together with Nd/Sm data indicating that 3.0 Ga crust underlies only the western part of Slave Province at 65°-66° N, suggest, that the assemblage developed outboard of, and was accreted to, an east-facing margin (present co-ordinates) (Kusky, 1989; King *et al.*, 1989; Davis and Hegner, 1990).

The nature and timing of the syn-D_2 continental-arc-type plutons suggests that by ca. 2608 Ma the central Slave Province had evolved into a contracting continental margin, probably by accretion onto a western basement craton. Combined crustal thickening and intrusion of the mantle-derived magmas into the crust resulted in crustal heating, partial melting and regional high-T/low-P metamorphism. By 2585 Ma large volumes of peraluminous granitic magmas were emplaced. At this time the presently-exposed structural levels were experiencing only minor shortening, retrograde metamorphic conditions and had been uplifted at least 5 km.

In summary, present data from the central Slave Province is most consistent with a general model involving assembly from remnants of island arc(s), syn-volcanic to syn-deformation turbidites and mantle- and crust-derived plutons related to an evolving accretionary zone, probably along an east-facing margin (cf. Hoffman, 1986; Kusky, 1989; King *et al.*, 1989; Davis and Hegner, 1990; Davis *et al.*, 1990).

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CORRELATIONS OF LOWER PALEOZOIC STRATIGRAPHY FROM SELWYN BASIN TO NORTHEASTERN BROOKS RANGE: PALEOGEOGRAPHIC AND RESOURCE IMPLICATIONS (105 O; 117 A, B, C & D)

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Detailed mapping of basinal facies rocks in the northeastern Brooks Range, northwest Yukon and adjacent Alaska, and data on the areal distribution of units and the role of facies changes are tentative. However, recent fieldwork in northwestern Yukon has shown that much of the pre-Mississippian strata there are correlative with basinal facies of Lower Paleozoic rocks exposed elsewhere along the paleo-Pacific and paleo-Arctic margins of Canada. In particular, Cambrian to Devonian strata in northwestern Yukon are similar to time-equivalent strata in the Selwyn Basin of southeastern Yukon and western Northwest Territories. The lithologic correlation over a distance of 1000 km are strengthened by biostratigraphic ties at Lower Cambrian, Lower Ordovician and Lower Silurian levels.

The oldest of the correlative units is a distinctive maroon and green argillite containing centimetre to metre-scale beds of ripple cross-laminated siltstone and light grey quartzite.

the widespread occurrence of the trace fossils Oldhamia and Planolites documents and Early Cambrian age for this unit. Discontinuously overlying the Cambrian argillite is a finely laminated, locally ripple cross-laminated, medium grey limestone. The overlying Ordovician chert and argillite succession exhibits a variety of features common to both areas. They include variable colours including a distinctive dark bluish-green colour, a thin- to medium-bedded argillaceous lower part, and a more massive extensively bioturbated upper part which commonly forms conspicuous razor-back ridges. Early Ordovician graptolites have been collected from argillaceous beds in both areas. The Ordovician strata are overlain by rusty-weathering green argillite locally containing Early Silurian graptolites. A sequence of grey argillite, impure sandstone and chert-pebble conglomerate, locally containing indeterminate trails and burrows, and possible vascular plant fragments overlies the older units with apparent unconformity. A sequence of black calcareous shale with interbeds of calcareous siltstone, limestone and chert has yielded uppermost Lower Devonian conodonts.

A further similarity is in the occurrence of mafic volcanic and associated sedimentary rocks. In northwestern Yukon and adjacent Alaska, they are bracketed in age between Late Cambrian and Early Ordovician, whereas in the Selwyn Basin they range in age from Early Cambrian to Early(?) Silurian.

For paleogeographic reconstructions, the foregoing implies that deep water deposits off the margin of northwestern North America represent similar depositional systems with congruent variations in lithology. Thus tectonic and/or eustatic events affecting Selwyn Basin deposits were also responsible for similar effects reflected in basinal deposits at least 1000 km to the northwest, throughout Cambrian to Silurian time. The paleogeographic similarity apparently ends in the Devonian. Whereas the Devono-Mississippian Earn Group in the Selwyn Basin is interpreted as having been deposited in an extensional or trans-tensional basin, coeval rocks in northwestern Yukon and adjacent Alaska are interpreted as synorogenic deposits shed off a compressional mountain range. The Devonian orogenesis was accompanied by isoclinal folding and thrust faulting, and intrusion of Middle and Upper Devonian granitic plutons.

Although tin skarns and tungsten-molybdenum occurrences are associated with the Devonian plutons, the large-scale sediment-hosted lead-zinc deposits in the Road River Formation and Earn Group of the Selwyn Basin have not been found in the northwestern Yukon and northeastern Alaska. This may reflect the differing tectonic environments associated with the deposition of Devonian sediments in the Selwyn Basin and in the northeastern Brooks Range. Alternatively, it may reflect the reconnaissance level of mapping of the pre-Mississippian rocks in the northeastern Brooks Range.

THE IDA POINT GOLD SHOWING, HOPE BAY GREENSTONE BELT, NWT.

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The Hope Bay Greenstone belt is located in the Bathurst Block, in the northeastern part of the Slave Province. The Ida Point gold showing belongs to the northern most tip of the belt; it consists of gold-bearing quartz veins in shear zones at the contact between volcanics and a tonalitic intrusion.

Three vertically oriented schistosities are present at Ida Point: 1) pillows are symmetrically flattened on a ratio of 5:1 in a north-northwestern pattern, 2) early north-south to northwest steeply dipping, sinistral structures, and 3) late, northeast, steeply dipping, dextral and brittle structures.

Gold mineralization is located in the contact metamorphic aureole where the tonalitic intrusion is in ductile fault contact with the pillow lavas. Quartz veins in the northwest structures contain most of the mineralization. Gold is usually associated with arsenopyrite rich bands on the margins of the microsaccharoidal quartz, either on the edges or inside the grains, or as free gold disseminated in the veins. The veins are discontinuous and show very little vertical extension.

Northwest shear zones are usually chlorite +/- sericite schists with quartz veins and lenses. Sulphide minerals include in order of importance arsenopyrite, pyrite and minor chalcopyrite. Gold grades range from 0.04 to 3.40 oz/ton. Northeast shear zones and fractures are usually carbonate rich pencil schist. When quartz is present, it is smoky white with minor chalcopyrite, pyrite and rare arsenopyrite. Gold grades can range from 0.13 to 2.06 oz/ton. Four major events can thus be established at Ida Point.

1) Dominant lateral compression flattening pillow lavas and creating fractures, followed by quartz veining and Au mineralization.

2) Recurrent shearing of fractures with boundinage and folding of quartz veins in a sinistral fashion.

3) Intrusion of the tonalite

4) Northeastern dextral shearing and faulting with possible remobilization of Au mineralization related to the tonalite.

NANISIVIK - MAXIMIZING THE MINE LIFE - ORE RESERVE CHANGES

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The 1973 feasibility study which recommended bringing the Nanisivik mine (48 C/1) into production stated proven and probable ore reserves at 6.3 million tonnes. At the design mill capacity of 500,000 tonnes per year, the reserve satisfied the government's requirement for a minimum 12-year mine life.

After 13 years of operation, a total of 8.0 million tonnes had been mined and the total ore reserve stood at 5 million tonnes or 7 years at the current milling rate of 710,000 tonnes per year.

The doubling of ore reserves during the mine operation is a combination of geologic, economic and social factors. The presentation will illustrate the relative effects of regional, property and mine exploration, mining experience and economic conditions which have impacted on the definition of ore and variations in the mine reserve.

Property exploration has resulted in the delineation of 15 discrete zones, within four kilometres of the main orebody, containing over 80 million tonnes of pyrite. Only four of the zones were zinc enriched and have been developed to add one million tonnes of ore to the reserve.

Mine exploration has been concentrated in the 50 metres below the main lens. The keel structure of the main orebody with its horizontal enlargements at two distinct elevations but high variability longitudinally has provided 700,000 tonnes of ore with a reserve equivalent to three years operation.

The main lens on which the original reserves were calculated has proven to be consistent with the original interpretation, primarily due to its horizontal deposition. The 38% increase in ore production from this zone is a combination of conservative ore reserve calculation technique and varying metal prices.

Regional exploration over the 200 kilometre length of the host rock has failed to detect a deposit of sufficient magnitude and grade to stand alone as a mineral development or justify transportation to the Nanisivik facility.

GOLD IN THE INDIN LAKE BELT (86 B/3 & 6)

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Gold occurrences in the Indin Lake supracrustal belt are concentrated in the north-central part of the belt between latitudes 64°07'N and 64°31'N. The occurrences fall into three main types.

Type 1 occurrences include most of the large deposits in the belt. These are in competent rock units that underwent brittle rupture during emplacement of gold-bearing quartz-carbonate veins. A typical veining pattern for these occurrences consists of one set of veins parallel to, and a second set oblique to, lithologic contacts.

The Colomac and Goldcrest dykes are felsic subvolcanic sills that have been steeply tilted. They contain most of the gold-bearing veins on the Colomac property. The oblique set of veins in the Colomac dyke is the most prominent vein set at Zone 2.0, the section of the dyke presently being mined. These veins have a shallow to moderate dip and make an angle of about 30°-40° to the Colomac dyke. A second set of veins is subvertical and parallels the strike of the Colomac and Goldcrest dykes. Veins of the second set tend to follow mesoscale shear zones parallel to lithologic contacts and are most obvious where the host porphyry is strongly deformed.

In most other Type 1 occurrences (e.g. Cass deposit) the two sets of gold bearing veins are both steep to vertical. The first set strikes obliquely to subvertical stratigraphy and the second set is parallel to stratigraphy. Both sets of veins tend to follow vertical inhomogeneities such as shear zones in the host rock. At Cass at least some of the veins parallel to stratigraphy are coeval with left-hand transcurrent shear on vertical bedding and foliation; some oblique veins also occupy shear zones. For Type 1 occurrences, cross-cutting fractures and lineaments may be associated with increases or decreases in gold values along strike. Commonly, the obvious cross-cutting feature is a Proterozoic mafic dyke or late fault that presumably follows a pre-existing zone of weakness.

Type 2 occurrences consist of mineralized zones centred on intersections between faults at the margins of volcanic units enclosed by sediments. At both the Pop grid and Kim Main deposit fault networks have allowed the respective volcanic host unit to undergo extension and necking; the veins appear to have overlapped in time with the faulting. The Hillside showing (NAM 3 claim) and Barker vein are other examples of Type 2 occurrences.

Type 3 occurrences consist of vein systems in the sediments adjacent to mafic volcanics. At the Diversified property, most veins are in a north-trending shear zone in (incompetent) sediments adjacent to (competent) volcanics. Veins and mineralization are concentrated at the intersection of northwest-trending fractures with the north-trending shear zone. Proterozoic faults coincide with the northwesterly fractures which are believed to have undergone deformation started in Archean times and reactivated during the Proterozoic.

At the Treasure Island Main deposit, most gold is in quartz-flooded sediments on either side of a series of brittly deformed rhyolite bodies that impinge on mafic volcanics. Auriferous gossans are common where shear zones cut across stratigraphy; in the sediments gossans are associated with irregularly folded zones trending across stratigraphy. In Type 3 occurrences, competence contrast plays a role since the sediments are much more strongly deformed than the adjacent volcanics, which may have acted as a buttress during regional deformation. In addition to this there is a second similarity with the other types of gold occurrence: faults and fractures cutting obliquely across the major structural trend may affect gold values.

It can be concluded that orientations of tension veining and faulting vary from one locale to another. The three types of gold occurrences all involve interactions between pairs of rock types that have a large competence contrast. Similar occurrences are not expected to exist far outside the area of greenschist facies metamorphism.

MEADOWBANK RIVER PROPERTY BAKER LAKE AREA, NORTHWEST TERRITORIES (66 H/1)

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History and Previous Work

In 1981, following four years of exploration for uranium mineralization in the Baker Lake area, N.W.T., a chloritized intermediate sulphide-bearing volcanic boulder containing 0.19 oz/ton gold and an outcrop of felsic crystal tuff, previously mapped as quartzite, containing up to 560 ppb gold, were discovered on the Phoenix property by Comaplex Minerals Corp., located approximately 40 miles west of Baker Lake in the southwest part of what is now termed the Tehek-Woodburn Archean volcanic-sedimentary belt. This was the first recorded occurrence of gold in the Baker Lake area.

In 1983, the re-evaluation of a previously reported arsenopyrite occurrence in the Meadowbank River-Woodburn

Lake area 60 miles north of Baker Lake resulted in staking two mineral claims to cover two occurrences containing gold values ranging from 0.003 to 0.13 oz/ton with silver values up to 4.1 oz/ton - one in felsic volcaniclastic rocks and the second in sulphidized iron formation.

In December 1984, Comaplex acquired two mineral permits to supplement the mineral claims staked previously in 1983.

The July-August 1985 program conducted by Comaplex on the Meadowbank River property discovered five gold occurrences, the most significant consisting of gold, silver and base metal mineralization within a felsic tuff unit associated with intense alteration and quartz veining. A total of 63 grab samples returned values up to 4.08 oz/ton gold, 19.8 oz/ton silver and appreciable concentrations of copper, lead, zinc and molybdenum.

In September 1985, a joint venture agreement was signed with Asamera Minerals Inc. covering both the Meadowbank River and Phoenix properties and during the period November 1985 to February 1986 an additional 415,000 acres were acquired in the area to extensively cover the volcanic stratigraphy believed to be potentially favourable to host gold occurrences.

During 1986 an exploration program, managed by Comaplex, was conducted on both properties. Two occurrences that were drill tested in the Meadowbank River portion of the property returned narrow intersections up to 3.3 feet, with erratic gold values varying from less than 0.1 oz/ton gold to 0.98 oz/ton gold. In the southeast part of the Meadowbank area numerous narrow, high-grade, hydrothermal quartz-carbonate, gold-arsenic-bearing vein occurrences were discovered spatially associated with sulphide iron formation dispersed within a 27 by six mile northeast trending, mainly overburden covered area.

On the Phoenix prospect, ground geophysics further defined a 2.5 mile long airborne electromagnetic conductor within an area underlain by a poorly-exposed sequence of sedimentary and volcaniclastic rocks. A soil geochemical survey delineated zones containing highly anomalous gold values coincident with the electromagnetic conductor which defines a sulphide iron formation within the volcanic stratigraphy.

In 1987, the main focus of the program was directed to the turbidite-hosted iron formation sequence underlying the southeast third of the Meadowbank River property. The most encouraging results came from a new discovery, the Third Portage occurrence, located in the southwest part of the area from which a composite chip sample of sulphidized magnetite-chert-iron formation returned 0.5 oz/ton gold over a two foot width.

On the Phoenix prospect, a 4,400 foot diamond drill program was conducted to test an overburden-covered banded iron formation with associated anomalous soil geochemical gold concentrations. Only geochemically anomalous concentrations of gold were encountered.

Further follow-up geological mapping and prospecting, conducted in August 1988 to cover the Third Portage discovery, returned representative grab sample results up to 2.76 oz/ton gold with a total of 10 samples returning greater than 0.29 oz/ton gold, strongly suggesting that this new discovery further indicated the presence of a previously unrecognized geological environment having a high potential to host economic gold deposits.

In February 1989, six prospecting permits were acquired for a total property area of 241,800 acres.

In March 1989, a joint venture agreement was signed by Comaplex and Asamera whereby Agnico-Eagle Mines Limited, Hecla Mining Company and Lucky Eagle Mines Limited, a newly formed exploration company jointly owned by Agnico-Eagle and Hecla, are presently participating under an option agreement to spend $3.5 million to earn a 55 percent interest in the project from joint venture partners, Comaplex Minerals Corp. and Asamera Minerals Inc., who presently hold 40 percent and 60 percent, respectively.

The 1989 exploration program, managed by Comaplex, focused on detailed follow-up on the Third Portage gold discovery. Prior to diamond drilling, ground magnetic and electro-magnetic geophysical surveys combined with detailed sampling was completed over the showing area. The results indicated a zone of highly anomalous gold values in frost-heaved iron formation coincident with magnetic highs and strong electromagnetic conductors.

Twelve of the 13 diamond drill holes, covering a 1,300 foot strike length, tested the Third Portage mineralized trend to a 300 foot depth. All 13 holes contained gold values indicating the zone to be open on strike and to depth and all contained visible gold. The gold mineralization occurs in two types of settings:

1)pyrrhotite-bearing replacement zones within magnetite-chert-iron formation; and

2)silicified pyrite/quartz shear zones flanking the main iron formation.

Two of the better intercepts on the Third Portage discovery were returned in Holes 10 and 13, located at each end of the mineralized trend, spaced 1,300 feet apart. Drill Hole 10, at the north end, intersected a 45 foot section averaging 0.464 oz/ton gold and Hole 13, at the south end, cut 15.7 feet averaging 0.598 oz/ton gold.

Also, Hole 11, drilled on an island located 1,000 feet southwest of the Third Portage discovery to test a gold bearing frost-heaved iron formation flanked by a strong EM conductor under the lake, intersected 6.6 feet averaging 0.415 oz/ton gold.

Prospecting and mapping located another showing approximately one mile along strike and north of the Third Portage discovery, designated as the North Portage showing. Grab samples returned up to 1.4 oz/ton gold in a similar geological setting as Third Portage. In addition, other promising geophysical targets were outlined underlying the lake north and south of the Third Portage discovery.

1990 Meadowbank River Property Results

During the summer months of 1990, a 27 hole diamond drill program comprising 8,563 feet was completed on the

Third Portage occurrence. The remainder of this presentation will focus on the results of the 1990 program.

GEOLOGY OF THE COLOMAC GOLD DEPOSIT

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NorthWest Gold Corp.

The Colomac Mine (86 B/6) is located 220 air km north of Yellowknife, N.W.T. The mine is in the metavolcanics of the Yellowknife group, in the Indin Lake Greenstone Belt of the Slave Province. Two parallel, quartz feldspar porphyry units (Colomac Dyke and Goldcrest/Dyke Lake Dyke), striking approximately N, 11°E and dipping 85°E, are gold-bearing and have been explored since 1945. Since 1986, Neptune Resources (NorthWest Gold Corp.) has brought Zone 2.0 of the Colomac Dyke into production at a rate of 10,000 tons/day. All major construction is complete and the mine is at the forecasted mining rate.

The interpretation of the mine's geology has evolved since pre-production started in November 1989. The andesite hanging wall usually has a sharp contact while the diorite/quartz diorite footwall contact tends to be more gradational. Andesite xenoliths also occur near or at the footwall contact. The gold within the quartz feldspar porphyry unit (QFP) is confined to the numerous quartz veins in the dyke. Quartz vein studies indicate that there is a preferred orientation to the veins in Zone 2.0 of 354° Az, dipping 49° east. Numerous faults crosscut and displace the QFP unit. Late stage diabase dykes also crosscut the metavolcanics.

Grade control will be one of the key factors in the success of the Colomac Mine. All production holes in the QFP, quartz diorite as well as contact zones are sampled with autosamplers. At present, an upper and lower sample are taken from each hole. Each sample is visually inspected for colour, % quartz, % sulphides and a visual estimated grade is assigned to it. The samples are assayed at the on-site assay lab. There are two atomic absorption spectrometers, two fire assay furnaces and complete wet lab facilities available. The lab is usually able to provide a 24-hour turnaround. The samples are cut to 0.145 oz/t and weight-averaged per hole and then averaged over the entire blast. Clustering of assay hole data is used for grade control purposes, rather than the individual holes in the blast. All ore muck piles are inspected after the blast. Portions of the pile are staked according to grade and final destination (crusher, stockpile(s), waste). All faces are mapped and plotted on 1"=40' bench maps. The blasthole information, the geology, the ore/waste contacts, the sections and block model are all used to plan out the blasts on the next bench down.

At present, Zone 2.0, Zone 2.5 and Zone 3.0 of the Colomac Dyke are scheduled to be mined. These three deposits give an overall mine life of approximately eight years.

THE SLAVE PROVINCE, "A VESTIGE OF THE BEGINNING"

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The Slave Structural Province (SSP) is a piece of highly evolved Archean crust; a granite-greenstone terrane composed 60% of granitoids varying in age from 3.96 to circa 2.6 Ga. Supracrustals of the Yellowknife Supergroup (YkSG) which make up about 35% of the SSP, are primarily grey not green, for they are 80% greywacke, hence one must distinguish between volcanics (greenstone) and turbidites (greywacke-mudstone) when discussing the SSP.

Granitoids formed around 3.96 Ga include tonalites and granite gneisses of the Acasta Terrane, the oldest intact rocks on earth. Those emplaced after 2.65 Ga are potassic, strongly radioactive, and have associated rare-element pegmatites, attesting to their highly evolved nature. Such granitoids must develop from pre-existing sial, evidence for which is widespread in the SSP.

The SSP is characterized by irregular to amoeboid supracrustal basins (or basin remnants) that were filled between 2.7 and 2.65 Ga with YkSG volcanics and turbidites (YkSG-VTS). Recent mapping and dating have identified, a pre-YkSG-VTS quartz-arenite succession in a number of places. Although evidence for sialic basement has been found at many places in SSP only six areas have given dates that are clearly pre-YkSG-VTS, that is older than 2.8 Ga. All are in the west part of the SSP. Mapping has also found iron formation to be common, widespread and of many varieties, contrary to claims that the rarity of iron formation contrasts the SSP with other Archean terranes. An areally extensive quartz-magnetite banded iron formation (BIF) just north of Yellowknife reaches thicknesses of well over 30 m. Similar rocks have been found beneath other volcanic belts, where they are associated with quartzarenite and ultramafic dykes and sills. More rarely they are interbedded with or overly felsic volcanic rocks. Economically important are the widespread and locally abundant sulphidic iron formations in turbidite sediments overlying (or perhaps facies equivalents to) volcanics. These units are referred to as amphibolitic iron formation, but sulphide (mainly pyrrhotite) is most important as it accompanies gold in the iron formation.

Features of the SSP include:

(1) Extensive areas of highly evolved 2.65 to 2.6 Ga granitoids;

(2) Extensive areas of greywacke turbidite; 25% of the SSP is turbidite;

(3) Two distinct types of volcanic belt: (i) Yellowknife type, dominated by tholeiitic basalt to andesite and (ii) Hackett River type, dominated by calc-alkalic intermediate to felsic volcaniclastics; In most cases initial volcanism in both types of belt is felsic not mafic, although some of this volcanism may be pre-YkSG-VTS.

(4) Absence of ultramafic flows; komatiite lavas have not been found in SSP volcanic belts.

(5) Volcanic massive sulphide (VMS) base metal fields in the SSP are rich in zinc, lead and silver and low in copper and gold.

(6) Most SSP gold deposits formed before the height of regional metamorphism and prior to the major phases of deformation and before terminal Archean granitoid intrusion;

(7) Evidence suggesting that the volcanics represent the margins of depositional basins is widespread.

(8) Quartz arenites, locally with paleosol, and felsic pyroclastics, which together indicate erosion of pre-existing sial, and deposition on a stable shelf, followed by ensialic volcanism, have been found at the base of 9 volcanic belts in SSP.

Slave Province Mineral Deposits

There are both Archean and Proterozoic mineral deposits in the SSP. Proterozoic deposits include silver-rich veins, nickel-copper-cobalt arsenide bearing veins, and beryllium rare-earth deposits in the pegmatoid phases of a hyper-alkaline syenite. Archean deposits include numerous types of gold deposits, silver rich volcanogenic base metal sulphide deposits, (VMS), and rare element pegmatites. So far only the gold deposits have sustained profitable production.

Based on the distribution of gold showings SSP can be divided into five zones. Four of these trend across the province from southwest to northeast. A southeastern zone is barren of gold showings, a second zone to the north is characterized by abundant quartz-vein deposits in turbidites. This zone contains the major Yellowknife shear zone deposits and the quartz vein and felsic volcanic deposits in the Courageous Lake volcanic belt (Red-24, and Tundra Project deposits). A Northwestern Zone is characterized by an abundance of auriferous quartz veins in granitoids. The Lupin Zone lies between the Northwestern and the southern zones. This, the largest zone, trends across the middle of the province and contains all turbidite iron-formation-hosted showings in the SSP, including the Lupin deposit. The Indin Zone is a much smaller zone at the west end of the Lupin Zone. It encompasses the Indin Lake supracrustal domain which is devoid of iron formation hosted-deposits but contains most other types. Of note are the small high grade Kim and Cass deposits and the huge Colomac Dyke deposits all developed in fractured volcanics or sub-volcanic intrusives.

Some as yet undetermined control, perhaps on timing of deposition or availability of favourable lithologies, channelled gold in the **Lupin Zone** into iron formations, whereas in the other zones gold was deposited in or with quartz veins in structural sites rather than in "lithological-chemical" sites. The restriction of turbidite-hosted amphibolitic iron formation to the Lupin Zone is clearly of major importance.

Volcanogenic massive sulphide deposits (VMS) are widespread in the SSP. All deposits of potentially economic size and grade are associated with Hackett River type volcanic belts or with sections of Yellowknife type belts that contain thick sequences of rhyolite as in the Beaulieu River volcanic belt. SSP VMS deposits contain little gold but are rich in silver, lead and zinc.

There is no zoning of VMS deposits in the SSP other than their obvious association with calc-alkalic volcanics. Their high silver-lead and low copper-gold content suggests an association of the volcanics which host them with the highly evolved granitoids that invaded the SSP after deposition of the YkSG-VTS, in which case the volcanics and granitoids are probably too closely related in time for the granitoids to have been derived by subduction of the YkSG-VTS. Most likely the volcanics, their associated VMS deposits, and the highly evolved granitoids are all related to anatexis of a pre-YkSG-VTS continental crust.

R.I. Thorpe (personal communication) reports that galenas from VMS deposits west of a line trending approximately north northwest across the SSP contain leads enriched in $^{207}Pb/^{204}Pb$ relative to leads from VMS galenas collected east of that line. This major isotopic boundary lies just to the east of a zone containing a number of pre-2.9 Ga basement remnants and platformal arenites associated with banded magnetite-quartz iron formations and felsic volcanics which locally are cut by ultramafic (komatiitic) sills and dykes. Presumed granitoid basement to the east of that line has not yielded pre-2.9 Ga ages. Thorpe also reports that almost all gold deposit Pb/Pb ages are younger than YkSG-VTS ages, and those to the west of that boundary show no significant differences from those to the east. This could be because gold deposition, and magmatic-anatectic events which developed the gold-bearing fluids, took place long after assembly of a proto-SSP. Confinement of the high $^{207}Pb/^{204}Pb$ ratios to the west of the isotopic boundary suggests that VMS on the west formed from older crust than did those to the east and that the boundary may be a major tectonic break. However, similarities in YkSG-VTS across that line, gold deposit zoning and rare-element pegmatite fields in the YkSG-VTS that ignore the line completely, and the lack of any obvious control on Pb/Pb ratios for galenas collected from gold deposits across the SSP, suggest that the isotopic boundary must represent a pre-YkSG-VTS event. Perhaps the isotope-boundary represents or is parallel to the suture of a pre-2.8 Ga accretion.

Tectonic models for the Slave Structural Province (SSP)

Attempts to interpret the SSP in plate tectonic terms have not been successful, whereas reasonable scenarios have been proposed for plate tectonic assembly of surrounding Proterozoic terranes. The latter processes have left their imprint on the SSP in both its younger rock and mineral deposits and in fracture and fault patterns, whereas Archean mineral deposits show no relationship to and in fact pose major problems for recently proposed SSP Archean plate tectonic models.

Four scenarios proposed for the SSP include: (1) **McGlynn and Henderson** suggested that YkSG-VTS were deposited in intracontinental rift basins, with volcanism mainly along basin-margin faults; (2) **Helmstaedt *et al.*** presented the first plate tectonic model in which YkSG-VTS mafic volcanics were seen as products of Archean seafloor spreading; (3) **Kusky** divided SSP into four separate terranes - Hackett River volcanic terrane (magmatic arc), Contwoyto terrane (accretionary prism), Anton terrane (microcontinental fragment), and Sleepy Dragon terrane (an equivalent? to Anton); SSP is considered to have evolved as a west-facing subduction complex, which subsequently collided with the Anton microcontinent; (4) **Hoffman** develops the SSP as a prograding arc-trench system (direction unspecified) forming a collage of arc volcanic and plutonic rocks, fore-arc basin deposits, and exotic blocks, possibly including seamounts, and fragments of ophiolite and sial scraped from the subducting plate.

Hoffman's model is not a model but a philosophical statement and as such it probably applies to some stage in the formation of all Archean Cratons. It may be directly applicable to the Superior and Yilgarn Structural Provinces which both display a strong linear zonation compatible with plate tectonics. The SSP however, does not display such linear zonations, and the likelihood of finding any, after fifty years of geological mapping, is extremely remote.

Kusky's model shows as key elements terranes and terrane boundaries that simply do not exist. In fact turbidites in a broad zone stretching across the central SSP are not distinguishable lithologically. All contain abundant amphibolitic iron formation associated with felsic-intermediate volcanic piles that can be equated with Kusky's Hackett volcanic arc. However, felsic volcanics are not confined to the "Hackett Terrane" but are abundant elsewhere. Kusky's proposed northerly trending sutures cannot be drawn without crossing numerous northeasterly trending supracrustal units.

Mineral deposit zoning in the SSP does not fit Kusky's terranes, and in fact denies their validity. In spite of the attractiveness of his model there is little to support its details and much to falsify it.

The Helmstaedt *et al.* model is much less detailed than Kusky's and therefore is more difficult to falsify. In the "Helmstaedt" model the sheeted dyke complex at the base of the Kam Group is considered to have formed on oceanic crust following rifting and spreading of granitoid crust. Later closing of the "ocean" accompanied by subduction (direction questionable) resulted in formation of extensive granitoid terrane, the Western Plutonic Complex. But that complex is too highly evolved to have formed from subduction of Archean oceanic crust; there is as yet no recognized evidence for the subduction zone or for a suture connected to it within the YkSG-VTS; the chemistry of the Kam Group is incompatible with a mantle source; and finally, currently available isotopic ages for the YkSG-VTS suggest the eastern calc-alkalic belts are significantly older rather than younger than those to the west which is incompatible with the Helmstaedt model as it is currently enunciated.

Work in the Yellowknife Supracrustal Basin has found a BIF-quartzarenite package preserved here and there beneath the YkSG basaltic volcanics. At Yellowknife a thin sequence of felsic volcanics, quartzarenite, banded chert magnetite and locally sulphidic iron formation has been recognized beneath the basaltic Kam Group. Zircons from quartzitic phases of the arenite give a U/Pb age of 3.0 Ga (Bowring, Personal communication, 1989), attesting to a pre-YkSG basement provenance. This sequence is interpreted as part of a widespread pre-rifting quartzarenite-BIF-volcanic succession deposited on thinned and subsiding pre-2.8 Ga continental crust. This widely developed, early, relatively mature clastic succession suggests erosion of a dominantly sialic terrane and deposition on a stable platform prior to mafic volcanism and turbidite deposition, (the YkSG-VTS).

A major weakness claimed for the **Henderson-McGlynn rift model** is its inability to explain and provide a mechanism for making sialic crust. This would be a fatal criticism if the granitoids had to be derived from the YkSG-VTS by subduction, but there are alternatives for the formation of high-pressure low-temperature metamorphic terranes such as the SSP by, for example, homogeneous shortening and thickening of tectonically thinned sialic crust and overlying supracrustals. An early global differentiation could have produced early Archean continental crust that through meteorite bombardment, 'second differentiation', and basaltic magmatism produced large areas of granite greenstone crust prior to commencement of plate tectonics. If extensive granitoids and migmatites can be developed from tonalitic crust by high-P, low-T processes, presumably without subduction, plate tectonics can be viewed as recycling rather than creating continental crust, and one objection to the Henderson-McGlynn model vanishes. This scenario fits the SSP where a number of lines of evidence suggest that the granitoids of the SSP and the YkSG-VTS with its deposits of VMS base metals, gold and rare element pegmatites were derived from the same sources, which however, were not uniform.

Plate tectonism could have assembled a SSP precursor prior to 2.8 Ga on which the YkSG-VTS developed. The extensive development and preservation of YkSG-VTS also suggests the Slave craton was highly evolved and included large areas of continental crust by at least 2.7 Ga, otherwise most of the sediments would have been tectonically or anatectically destroyed during cratonization.

The Slave Province is a unique segment of Archean Crust. It contains rocks that date from just after the earth formed and yet contains rocks displaying well preserved, in places almost pristine, sedimentary and volcanic structures. Thus it is an ideal laboratory for the study of the first two billion years of earth history.

Reference

This abstract was condensed from an extensive review of the SSP available as part of Geological Survey of Canada Open File 2168 prepared for the 1990 International Association for the Genesis of Ore Deposits field trip to mineral deposits in the Slave Structural Province. That paper refers to much of the recent literature on the SSP.

ASPECTS OF GEOCHRONOLOGY AND GEOCHEMISTRY IN PORTIONS OF THE HEARNE PROVINCE, FROM PADLEI TO RANKIN INLET, N.W.T., 55 K/4, 55 L/4, 55 L/7, AND 65 H/11.

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Four groups of rocks from the Hearne Province in the region from Padlei to Rankin Inlet were considered in this study: The Kaminak Group of the Rankin-Ennadai Greenstone Belt, the Kaminak (pre-Hurwitz) dykes, the Spi Lake Group, and the Hurwitz Group. The Kaminak Group is unconformably overlain by the Spi Lake Group, and is cut by the Kaminak dyke swarm. Stratigraphic linkage between the Spi Lake Group and Kaminak dykes is uncertain. The Hurwitz Group unconformably overlies the Kaminak Group and the Kaminak dykes. Stratigraphic relationships indicate

that the Spi Lake Group was deposited either before, or roughly contemporaneously with, the lowermost unit of the Hurwitz Group. All rocks in this area have been affected by late Early Proterozoic tectonism, and have been metamorphosed to greenschist facies.

Geochemical analyses using XRF and Neutron Activation techniques have been performed on igneous rocks from the four groups listed above. Uranium/lead age dates have been obtained from the Kaminak Group and the Hurwitz Group.

Kaminak Group volcanic rocks range from basaltic to rhyolitic in composition. A U/Pb zircon age of 2681 +/- 2 Ma has been obtained from a rhyolite sampled south of Quartzite Lake. Mafic rocks from this volcanic suite show flat REE patterns, typical of Archean tholeiites. TiO_2 content ranges from 1.0-1.8%, slightly higher than normal. Rubidium content less that 10 ppm for each sample suggests that these are not continental tholeiites, and Ba values less than 20 ppm for all samples indicates that these are probably not arc generated tholeiites.

The Spi Lake basalts are very fractionated continental tholeiites, with low Mg and high Fe values, and Rb ranging from 50-70 ppm. These rocks show a slight enrichment in light REE, typical of continental tholeiites. Analysis shows Zr/Y values of 7.5, and La/Yb ratios of 11.0.

The Kaminak dykes are basaltic in composition, and chemically have a continental tholeiite signature. These dykes have La/Yb ratios of 8.6, and Zr/Y values of 6.0. These rocks are less enriched that the Spi Lake basalts, more enriched than mafic rocks in the Hurwitz Group, and show signs of crustal contamination. The Rb content ranges from 14-41 ppm, approximately double that in the Hurwitz Group.

Mafic igneous rocks from the Hurwitz Group appear to be typical continental tholeiites. Rubidium ranges from 14-20 ppm, and Ba from 100-400 ppm. These rocks are significantly enriched in light REE, and have Zr/Y ratios of 4.8 and La/Yb values of 5.4. Uranium/lead analyses of baddeleyite grains from a gabbro in the Padlei Belt of the Hurwitz Group give an upper intercept age of 2094 +26/-17 Ma. This age date, in combination with the geochemical results, suggests that magmatism and deposition of supracrustal rocks in much of the Hurwitz Group was not genetically related to the Trans-Hudson orogeny. Rather, the mafic magmatism may be related to an earlier episode of crustal destabilisation and extension, possibly rifting related to the opening of the Manikewan Sea.

COMPARISON OF TIMING OF STRUCTURES BETWEEN POINT LAKE AND CONTWOYTO LAKE (76 E & G)

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The Point Lake and Contwoyto Lake areas have apparently similar structural and metamorphic histories, although it is not known how much of these histories are shared. Examination of an area between Point and Contwoyto Lakes suggests that the earliest deformation recorded at Point Lake preceded the first structures preserved at Contwoyto Lake, and that late Archean deformation at Contwoyto outlasted Point Lake deformation.

Both areas record two episodes of isoclinal folding (D1, D2) followed by two sets of cleavages with little or no associated folding (D3, D4). At Contwoyto Lake, the thermal peak of high T/low P metamorphism accompanied D2, whereas at Point Lake, metamorphism was synchronous with D4 (see table).

Point Lake	Contwoyto Lake	
D1-isoclinal folds (F1) -no clvg	(early def'm history not observed)	
D2-isoclinal folds (F2) -no clvg		
D3-NW-striking clvg (S3) -no folds	D1-isoclinal folds & clvg (F1, S1)	T I
*D4-NE-striking clv (S4) -no folds	*S2-isoclinal folds & clvg (F2, S2)	M E
	$D3_{NW}$-NW-striking clvg & open folds ($S3_{NW}$)	
*denotes the thermal peak of metamorphism	$D3_{NE}$-NE-striking clvg & open folds ($S3_{NE}$	

Pre-thermal peak foliations at Point Lake are consistently oriented NW (S3), and a syn-thermal peak fabric (S4) is consistently NE-striking. Both fabrics transect the axial planes of F1 and F2 isoclinal folds, which have little or no axial planar fabric associated with them. At Contwoyto Lake, the pre-thermal peak fabric (S1) is commonly oriented parallel or slightly oblique to the main thermal peak foliation, because the earlier cleavage has been isoclinally folded during F2. Conjugate NW and NE crenulations ($S3_{NW}$ and $S3_{NE}$) cross cut S2.

The NW and NE cleavages at Point Lake have not reoriented earlier (F1 and F2) folds, whereas at Contwoyto Lake, F1-F2 interference patterns occur in various orientations due to macroscopic cross folding related to the two late cleavages.

This summer, an area between Contwoyto and Point Lakes was studied in the hope of correlating some structures between them. A northeast-striking, syn-metamorphic cleavage can be traced into the study area from Point Lake, where it appears to be axial planar to isoclinal folds of bedding, and is transected by rare NE and NW-striking crenulations. This thermal-peak fabric, S4 at Point Lake, can be traced onto the Contwoyto Lake sheet, where it coincides with S2 of King *et al.* (1989). Domains of the late NE and NW cleavages become more common and better developed further east towards Contwoyto Lake.

There are two "end member" models which could explain the different timing of structures and metamorphism at Point Lake and Contwoyto Lake. In the first, the four sets of structures in both areas are correlative, and a thermal front propagated from east to west, producing a diachronous thermal peak. In the second model, metamorphism was

synchronous in the two areas, D1 and D2 at Contwoyto Lake were coincident with D3 and D4 at Point Lake, and the earlier structures at Point Lake have not been recognized (never formed?) at Contwoyto. As the syn-thermal peak foliation could be traced continuously between the two areas, the latter model is favoured. A potential test for this model might be to identify and date syn-metamorphic plutons in the Point Lake area, and compare them to the age of syn-metamorphic plutons already dated from Contwoyto Lake.

STRATIGRAPHY, STRUCTURE AND METAMORPHIC PETROLOGY OF THE TURNER LAKE AREA, N.W.T. (76 N/2 & 3)

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The Archean Turner Lake - Pistol Lake greenstone belt west of Bathurst Inlet, N.W.T. is composed of a homoclinal succession of supracrustal rocks, dominated by greywacke to mudstone turbidites. This supracrustal sequence has been metamorphosed to regional amphibolite grade. The supracrustal rocks are intruded by granitoid and related pegmatite bodies which are in turn intruded by large Proterozoic sills and dykes. Excellent exposure (approximately 80%) across the entire area and lichen-free outcrops along the James River, allowed for detailed mapping to be completed.

Four stratigraphic units define the laterally extensive supracrustal sequence. From the base, these are: (Unit 1) greywacke to mudstone turbidites; (Unit 2) conglomerate (James Falls conglomerate); (Unit 3) a stratigraphically complex sequence of intercalated conglomerates, arenites, volcanic, hypabbysal and volcaniclastic rocks; (Unit 4) greywacke to mudstone turbidites. The thin to medium bedded turbidites are concentrated on the eastern and western margins of the map area with Units 2 and 3 forming a central belt.

Unit 1 greywacke to mudstone turbidites in the eastern part of the study area are typified by cryptic bedding (S0) and bedding-parallel foliation (S1) which is enhanced by quartz stringers. Greywacke dominates over mudstone. Unit 4 turbidites to the west contain approximately equal proportions of mudstone and greywacke. They are vein-poor and have excellent tops criteria including graded bedding from greywacke to mudstone.

The James Falls polymictic orthoconglomerate, locally paraconglomerate (Unit 2), is exposed along the western margin of Unit 3. It forms an angular unconformity with the overlying Unit 1. Pebble to boulder-sized clasts include felsic volcanic, hypabbysal and sedimentary rock clasts (including ironstones) in a sandstone matrix. The clasts are identical in character to many of the supracrustal rock units of the belt. This conglomerate is highly deformed and clasts have developed a strong stretching lineation on bedding surfaces.

Unit 3, a stratigraphically complex sequence of intercalated rocks, lies as a central belt in the map area. Quartz-rich feldspathic arenites lie stratigraphically above, below, and are intercalated with volcanic, volcaniclastic, hypabbysal and conglomeratic rocks. The arenites are cross-bedded with fine planar laminations and contain no pelite. This is indicative of a shallow water depositional environment. Lenses of conglomerate similar to the James Falls conglomerate are dispersed within this sequence. A local conglomerate sub-unit containing mafic volcanic clasts in an amphibole-rich matrix is developed at the contact between greywackes and gabbros/diorites. Volcanic rocks of Unit 3 include mafic rocks of andesitic and basaltic composition and felsic rocks ranging from rhyolitic to andesitic composition. Gabbroic/dioritic rocks outcrop as discrete lenses and as synvolcanic bedding-parallel sheets which are too small to be mapped as distinct units but are included in Unit 3. Gold has been the target of exploration at Turner Lake for the last 26 years. It is confined to a single light weathering sub-unit of tholeiitic composition in a stacked sequence of light and dark weathering volcaniclastic rocks (part of Unit 3). The gold is present as visible gold associated with quartz veins in this unit.

Intrusive rocks include two granitoid plutons, the very weakly foliated, post-deformational biotite, muscovite Fishhook Lake monzogranite (FHLG) and the Pistol Lake biotite granodiorite. Associated with these are at least two phases of apatite-, tourmaline- and muscovite-bearing lithium-enriched pegmatites, which are most abundant near the FHLG. All of the rocks discussed thus far are cut by the N-NW trending Mackenzie diabase dykes and the E-trending Franklin diabase dykes. Proterozoic olivine gabbro sills east of Turner Lake and an isolated olivine gabbro sill west of Turner Lake intrude Unit 1.

Bedding is recognizable in Units 1, 4 and 5 and is frequently overturned and steeply dipping in the east-facing homoclinal succession. Locally, as at the main showing, tops are to the west. Regional fabrics include S1 trending NNE to SSW which is bedding parallel and is emphasized by quartz stringers. S2 trends NE and crenulates S1. Cordierite porphyroblasts are elongate along S2 which in most cases is clockwise to bedding. Many porphyroblasts exhibit rotation to this orientation. Andalusite porphyroblasts overgrow the cordierite. This alignment and overgrowth indicates that peak metamorphism occurred during D2. The fabric within the James Falls conglomerate and similar conglomerate clasts reflects the regional metamorphic fabric S1. No clasts with pre-F1 fabrics have been found and therefore the clasts do not represent a much older basement. Unit 3 preserves metre-scale folds with vertical, or nearly vertical fold hinges (F1). A high strain zone (HSZ) transects the map area and Unit 3. Sinistral shear indicators include C-S fabrics, rotated porphyroblasts, quartz veins and fragmented laminations. Map-scale E-W folding, as at the main showing, occurs immediately east of the HSZ but rapidly dissipates away from the HSZ.

Metamorphic grade is uniform across the area and is marked by the low pressure regional-scale amphibolite facies assemblage cordierite +/- andalusite +/- staurolite +/- garnet +/- sillimanite.

The plutonic and volcanic rocks of the map area will be dated by U-Pb geochronology as part of an ongoing mapping project of the entire belt by the Geological Survey of Canada. The dating will be used in this project to establish temporal relationships of this belt with adjacent belts of the Slave Province.

MARINE TRANSPORTATION IN SUPPORT OF MINING OPERATIONS IN THE CANADIAN ARCTIC

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Established as a joint venture between the Canadian government and industry, Canarctic's mission has been to develop a proven commercial marine transportation capability over the widest possible season for trading into and out of the Canadian Arctic. In order to achieve this corporate mission, Canarctic commissioned a Canadian design Arctic Ice Class 2 bulk carrier, the M.V. Arctic. Delivered in 1978, the vessel commenced its operations later that year in support of shipping concentrates from the Nanisivik Mine on Northern Baffin Island. In 1980 the M.V. Arctic helped carry much of the equipment and material used by Cominco to construct the Polaris complex and in July 1982, commenced the shipping season from Polaris on Little Cornwallis Island. M.V. Arctic continues to be the first ship to call at Nanisivik and Polaris each year, and is also the last vessel to visit the Arctic mines in the fall.

In support of the Company's efforts to expand the shipping season in the Arctic, an intensive program of research and development has been carried out. One consequence of this R&D effort was the conversion and structural upgrading of M.V. Arctic in 1985/86 with a new bow design and a sophisticated computer-based ice navigation system that led to a reclassification of the vessel by the Canadian Coast Guard to Arctic Class 4. The ice class upgrading has resulted in a potential shipping window of nine months in the eastern Arctic within the framework of the current Canadian Arctic Shipping Pollution Prevention Regulations.

The Company's focus has recently turned to the western Arctic and the potential shipping opportunities from the Coronation Gulf region. In-house studies of the mining activity in the Coppermine and Bathurst Inlet sector, and an examination of the east-west navigational constraints, have convinced us that commercial shipping in support of tidewater mining operations from the region is just a matter of time. From the shipping perspective, what is needed now is the completion of detailed bathymetric surveys, and detailed ice studies along the intended route and in the vicinity of the likely port site, in order to assist with vessel design and specification.

Further development of the mining sector in the Canadian Arctic will hinge on environmental, social, political, as well as economic factors. At Canarctic we believe the expertise exists to provide effective commercial marine support to the mining sector, and we are committed to playing a leading role in support of this development.

CARBON-RICH METASEDIMENTARY ROCKS AS CONTROLS FOR GOLD MINERALIZATION IN THE GORDON LAKE REGION, N.W.T.

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Field mapping within the Gordon Lake region (65°54'N, 113°15'W; 85 P/3 and 85 I/14) has indicated a close spatial association between the occurrence of black carbon-rich siltstones of the Archean Burwash Formation and stratabound, gold bearing, quartz breccias zones. Geochemistry of siltstone beds proximal and adjacent to the quartz-breccia zones confirm this increase in reduced carbon content, with a similar increase in gold grade. The quartz material within these breccias is predominately dark grey-black in colour; due to abundant microscopic opaque/non-reflective particles, possibly carbon. Boyle (1957) recognized similar particles within in the grey-black quartz from the Giant and Con mines at Yellowknife, which he concluded were graphite. These observation suggests that, in addition to the structural and lithological associations, carbon and gold are genetically linked.

Petrographic and thermometric analysis of fluid inclusions within the grey-black quartz at Gordon Lake indicates a predominance of secondary high salinity (approximately 25-30 wt % $NaCl$-$CaCl_2$ combined) aqueous inclusions, over CO_2-rich and possible H_2O-CO_2 inclusions. The low CO_2 values were confirmed by a preliminary bulk volatile analysis using a crushing/gas chromatography technique (Bray and Spooner, 1989)[1]. However, high CH_4 values (up to 5 mole %) were also obtained, suggesting the presence of a, previously unrecognized, methane-rich inclusion type.

The current structural model proposed for the concentration of gold bearing quartz-breccia bodies at Gordon Lake suggests that metamorphic fluids were focused into dilational openings within the core of a regional refold during late tightening of the hinge region. However, this model does not provide constraints on the exact mechanism by which gold and sulphides were precipitated and trapped. The consistent occurrence of carbon within the breccia zones indicates that the environment of mineralization was probably reducing. Thus a more efficient mechanism for the deposition of gold and sulphides would occur if the metamorphic fluid was oxidizing (Kubilius and Ferry, 1989). This contrasts with ideas of Kerrich *et al.* (1977), Kerrich and Fyfe (1989) and Swatton (1989) who suggest that the metamorphic fluids within the Yellowknife region originated as reduced hydrothermal solutions, that precipitated gold and sulphides during reaction with a more oxidized wallrock.

We prefer a model for the precipitation of gold and sulphides at Gordon Lake in which gold bearing, oxidized, metamorphic fluids were focused into a structurally prepared, carbon-rich "conduit" during tightening of the refold hinge. These fluids interacted with the carbon of the siltsone wallrocks, producing CH_4 as the principal volatile and increasing the salinity of the remaining fluid (similar to a reaction suggested by Bottrell *et al.* 1988 for the Dolgellau Gold Belt, North Wales). Gold was probably carried as chloride complexes which were destabilized during the reducing reaction. Carbon, oxygen and sulphur stable isotope analysis are being done to test and provide further constraints on this model.

If the mineralization hypothesis is acceptable it should pose a considerable bias in the investigation of similar gold occurrences within the Yellowknife Basin and regionally; whereby metasedimentary carbon-rich sequences become primary exploration targets for quartz veining and gold.

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[1] Fluid inclusion volatile analyses carried out by Colin Bray in association with Ed Spooner at the Fluid Inclusion Laboratory, Department of Geology, University of Toronto, Toronto, M5S 3B1.

THE CON INTRUSIVE CORRIDOR: NEW GOLD POTENTIAL IN THE YELLOWKNIFE GREENSTONE BELT

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At the locality of the NERCO Con Mine (85 J/8) an east-west trending thermal corridor can be traced outwards from the Western Granodiorite across the Yellowknife Greenstone Belt. Hornblende amphibolite facies hornfelsing with an associated aeromagnetic high defines the corridor which crosscuts both volcanic stratigraphy and regional metamorphic isograds. The corridor is a site for a series of granitic intrusive centres with associated breccia zones. These include the Pud stocks, the Negus plug, and numerous smaller granitic dykes well east of the Negus-Rycon vein system. Breccia bodies comprise deep-level granite-matrixed, intermediate-level quartz-feldspar porphyry related, and high-level gas corrosion types.

The Northwest Pud Lake breccia zone represents a deep-level intrusive system with two well developed brecciating phases relating to early gabbroic dyke and later granite emplacement. Regional north-trending porphyritic amphibolite dykes lose integrity into a zone of diorite-matrixed breccia with sharp-walled volcanic fragments. Pristine textured, medium-grained pink granite then forms a matrix to both diorite breccia and dyke blocks. The Southwest Pud Lake breccia defines a circular zone bordering an intrusive centre beneath the lake. Where exposed east of the Lake, the Pud stock is a white fine-grained granite characterized by high modal quartz and disseminated pyrite. Both feldspar porphyry and amphibolite dykes lose integrity into a domain of sharp-walled volcanic fragments. Dyke fragments occur along the projected path of bordering dykes. There is no definable matrix, suggesting a collapse mechanism of formation. The perimeter of this breccia zone is intruded by granite, while the breccia itself is intruded by quartz-feldspar porphyry. This breccia site, is interpreted as an annealed, in-situ collapse breccia that formed synchronous with prolonged bimodal intrusive activity. Bordering hornblende amphibolite grade volcanics commonly show corrosion by calcite-epidote-K feldspar streamers that subparallel dyke trends.

The Negus centre comprises a high-level porphyry with an overlying breccia cap injected by quartz-feldspar porphyry dykes. The Negus plug, transected for 200-feet on the 950-level of the NERCO Con Mine, is pervasively altered and hosts low grade Mo:Au mineralization. Similar to the Pud Lake breccias, late gabbroic dykes lose integrity into the Negus breccia zone. The initial stage of brecciation formed an irregular shaped body comprising various volcanic fragments and both layered pyroxenitic and high Fe-Ti gabbroic dykes. A later stage of brecciation relates to granite emplacement and quartz-feldspar porphyry dyking. The high-level nature of this particular breccia centre is supported by pegmatite pockets with comb quartz, microbreccia seams, and hydrothermal retrogression along sheeted joint sets to a chlorite-prehnite-calcite-phlogopite-sphene-quartz-pyrrhotite assemblage. Miarolitic cavities and micrographic textures within the Negus intrusive further signify a nearer surface setting. Well developed porphyritic textures typify very siliceous phases both within the intrusive and the external dyklets exposed on the surface.

Mafic dyking and granite intrusion appear closely coupled at all breccia centres, suggesting a closer temporal relationship than has been proposed. In general, with increasing distance from the Western Granodiorite the intrusive breccia centres demonstrate features indicative of formation at higher crustal levels. Intrusions become more evolved and breccia zones exhibit increased retrogression. In contrast to the fresh textured Pud stocks, the Negus plug is strongly altered to sericite-carbonate and its affiliated breccia shows retrogression to ankerite-pyrite-arsenopyrite-quartz. This alteration is notably similar to the gold-bearing shear systems. A model whereby high-level intrusive centres focused metamorphic fluids is hypothesized for the immediate Con Mine Site. Regional gold potential in the Yellowknife Greenstone Belt may therefore be greatest in areas of anomalous intrusive activity with attendant retrogression.

FAULT PATTERNS AND MINERALIZATION IN THE NORTHERN BEAULIEU RIVER VOLCANIC BELT REGION

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Recent studies of the northern Beaulieu River volcanic belt and adjacent gneissic and granitoid complexes (85 P/9, 10, 15 & 16) were centred approximately 175 km northeast of Yellowknife, NWT. Supracrustal rocks of the Archean Yellowknife Group are predominantly pillowed tholeiitic basalt. Fine- to medium-grained metagabbroic dykes are ubiquitous throughout all supracrustal rocks. Northeast of Prang Lake, metasedimentary rocks of the Beniah Formation underlie eastward younging volcanic rocks against a basement gneiss complex. Similar metasedimentary rocks, albeit lacking orthoquartzite and quartz-pebble conglomerate, are present as the easternmost supracrustal rocks. The broadly symmetric disposition of gneiss, metasediments and basalt about a nar-

row strip of felsic volcanic rocks suggests a synclinal structure in this area; younging directions were determined only west of the proposed synclinal axis. Other supracrustal rocks in the Prang Lake area are discontinuous or fault-bounded; the largest zone is traceable south to the westward younging belt in the McCrea-Drybones Lakes area.

An unusual (W.A. Padgham, pers. comm. 1989) heterogeneous suite of paragneiss, foliated granitoids and various intrusive phases crops out over much of the mapped area and is assumed to predate volcanism. Uncommon zones of sulphide- and magnetite-rich layers contain anomalous (100 ppb) gold concentrations. A 1.5 km^2 lens of the paragneiss complex, 14 km south of Prang Lake, comprises garnet-amphibolite and massive magnetite beds. Anomalous gold concentrations are present in this gossanous zone. A narrow gossan north of McCrea Lake along the western contact of the complex with porphyritic granite appears not to continue northward to the Prang Lake area.

A complex history of late faulting is recorded in the study area. Confirmed major displacements are everywhere subhorizontal: sinistral on north and the less common northwest trending fault zones and dextral on northeast trending zones. Massive coarse-grained reddish granite incorporating angular blocks of country rock delineates much of each fault zone. Ductile shear fabrics are present only locally. All rock units, except possibly Proterozoic mafic dykes, are transected by the faults.

The youngest fault in the area is expressed as a prominent north trending zone (up to 1.5 km wide) passing through westernmost Prang Lake and can be traced continuously for more than 180 km. This zone is characterized by anastomosing brittle to mylonitic subsidiary faults (duplex structures). Slivers of volcanic rock of unknown origin in the Prang Lake area suggest that local vertical movement accompanied the bulk 15 km sinistral displacement ("flower" or "tulip" structures).

A similarly oriented north-south fault east of Prang Lake appears to be displaced at least 6 km by a complex system of northeast trending dextral faults. Conflicting crosscutting relationships between north and northeast fault sets suggest approximate contemporaneity but dihedral angles are incompatible with a compressive conjugate system. Reactivation of some faults is probable.

Quartz veins associated with the late faults commonly contain base metals, primarily as chalcopyrite and lesser amounts of sphalerite and galena, and local anomalous concentrations of gold. Chalcopyrite in quartz veins through pyritic slates and siltstones of the Beniah Formation is common but no significant gold concentrations have been detected. Prospecting throughout the paragneiss complex may reveal other stratabound mineralization.

AEROMAGNETIC/GRADIOMETER/VLF-EM SURVEY, WHITEHILLS LAKE, NWT MAPPING OF IRON FORMATIONS AND MAFIC ULTRAMAFIC FLOWS

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An aeromagnetic, gradiometer, VLF-EM survey of approximately 6300 km, was flown in the Whitehill Lake area, NWT (56 D/12 & 13; 56 E/4; 66 A/9 & 16; 66 H/1) in July 1988. Line direction was SE-NW at a separation of 300 m and altitude of 150 m.

Field work in 1989 and 90 by J. and M. Henderson indicated that several horizons of iron formation with associated mafic-ultramafic flows can be traced discontinuously from Whitehills to Tehek Lakes. These formations are particularly evident in the gradiometer and imaged total field data.

CONTINENTAL PACIFIC RESOURCES INC'S ANIALIK-HIGH LAKE PROJECT: UPDATE 1990

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Continental Pacific Resources Inc. holds 115,000 acres of land in the High Lake and Anialik River greenstone belts (76 M/2, 6, 7, 11 & 12). Upon completion of the 1989 geological-geophysical programme and the 1990 geophysical programme, eight properties were selected for drill testing.

Sub-economic but very encouraging intersections were returned from the Char, No.8, Run, Telly, Jim and Rush properties.

The Telly property is a shear-related gold environment within a mafic pillowed sequence, while the remaining properties are massive sulphide targets commonly associated with a felsic/mafic stratigraphic interface.

It is very apparent from the 1990 drill programme that the High Lake and Anialik River greenstone belts have tremendous potential for hosting both massive sulphide and shear-related gold deposits.

Close proximity to a deep water access route can only enhance exploration interest within these two greenstone belts.

GEOLOGY, MINERALIZATION AND PROPOSED DEVELOPMENT, NICHOLAS LAKE (86 P/4 & 5)

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The Nicholas lake property is located 85 kilometres north of Yellowknife. It is underlain by Yellowknife group turbidites which have been intruded by two types of intrusions, one granodiorites and the second a biotite granite. The rocks have been metamorphosed to greenschist facies. The host rock for the mineralization at Nicholas is a granodiorite stock. The mineralization is an Archean quartz sulphide vein system. The shear hosted veins have an average sulphide con-

tent of 8% which is comprised of arsenopyrite, pyrite, pyrrhotite, sphalerite, galena and chalcopyrite. Sphalerite is the best indicator of gold mineralization in the rock since visible gold has been seen only in one of the veins (A7). The veins strike both east west and south-east and dip steeply to the south and south-west. The bulk of mineable reserves are located on two veins (A2 and A6) although the other veins are easily accessed by any underground development.

The current reserve estimate of mineable grade at a 6 gram cutoff is 450,000 tonnes at a grade of 13.09 grams/tonne. These reserves do not carry any weighting for the two deep holes drilled early in 1990. Both holes had ore grade intersections on the main veins two hundred meters below the deepest known intersections. The mineralization and the structure obviously continue to depth and indicate potential for more reserves.

The next stage for this property is an underground evaluation and bulk sample to confirm grade, continuity and final metallurgical testing. The program would include a ramp access to the deposit at 125 meters below surface where the bulk of the reserves are located, drilling both within the currently defined reserves and below to confirm continuity to depth, and obtain a bulk sample. A final feasibility would be prepared after this program with final engineering, and production permitting completed by the end of the first year. Mill construction, stope preparation and possible production in the second year. If this program was started in 1991 then production would occur in late 1992 or early 1993.